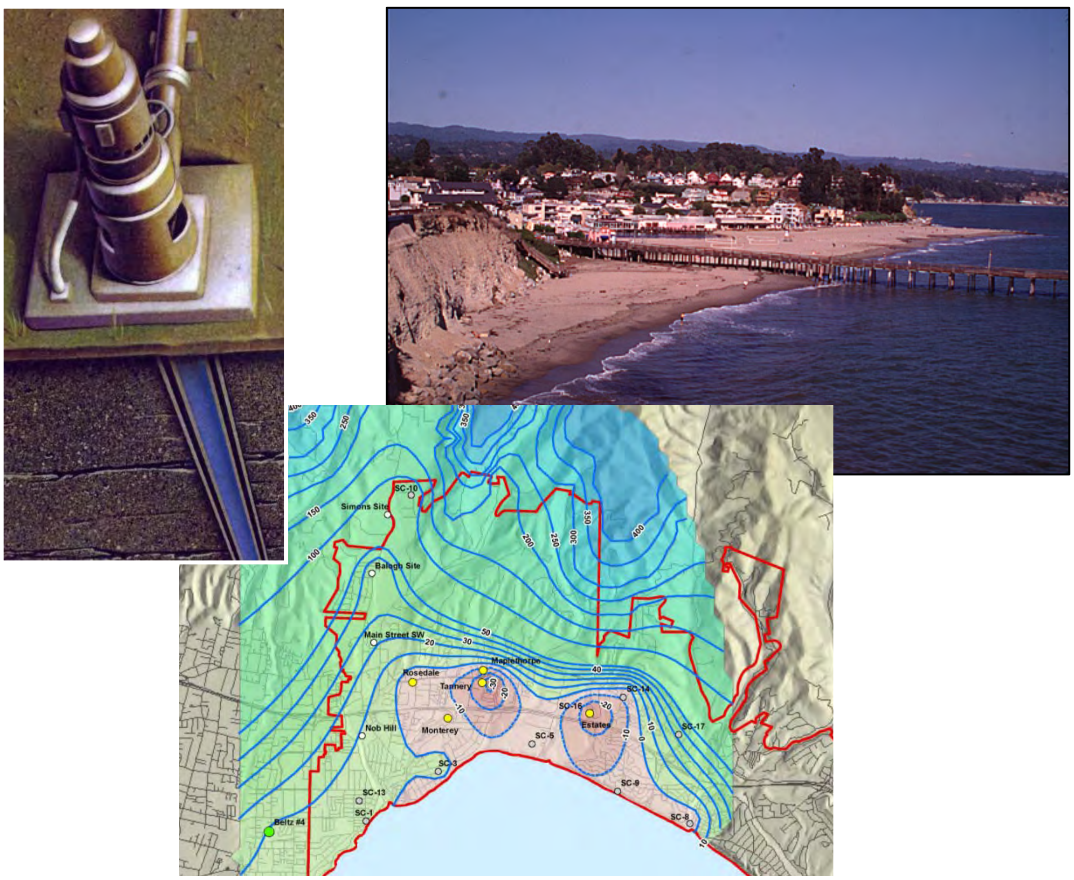
BASIN IMPLEMENTATION GROUP DRAFT

State of the Basin Update
Water Year 2008

Prepared for:
Soquel Creek Water District
Central Water District



Prepared by:

HydroMetrics LLC

July 2009

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ABBREVIATIONS

BAG..Groundwater Management Plan Basin Advisory Group
BIG..Basin Implementation Group
CWD.......................................Central Water District
GMP ....Groundwater Management Plan
gpd ....gallons per day
JPA..Joint Exercise of Powers Agreement
mg/L ....milligrams per Liters
msl ....mean sea level
PVWMA ....Pajaro Valley Water Management Agency
SqCWD ....Soquel Creek Water District
TDS...total dissolved solids

EXECUTIVE SUMMARY

This State of the Basin Update is the Annual Review and Report (ARR) for Water Year 2008 (October 2007-September 2008). An annual ARR is a requirement of the Soquel Creek Water District (SqCWD) and Central Water District (CWD) approved Groundwater Management Plan (SqCWD and CWD, 2007). This update summarizes groundwater conditions in the Soquel-Aptos area, documents the status of groundwater management activities, and recommends any amendments to the Groundwater Management Plan. Although it has limited analysis, this update includes representative graphics to present the hydrogeologic condition of the basin. A full State of the Basin report will be prepared every five years, with updates occurring for the in between years. The next full report will be for Water Year 2012.

The average precipitation in Water Year 2008 measured at the two gauges monitored by SqCWD was approximately 28 inches. This is greater than the precipitation measured in Water Year 2007, but still less than average annual precipitation of approximately 37 inches per year. This lower than normal rainfall for the second consecutive year translates to less groundwater recharge in the basin which in turn impacts groundwater in storage and groundwater levels.

SqCWD's groundwater pumping remained relatively low for the fourth year in a row, and for the first time was just below the sustainable yield goal of 4,800 acre-feet per year set in the Groundwater Management Plan. However, this goal is being re-evaluated. Total groundwater pumping by SqCWD was measured at 4,795 acre-feet, or 1,562 million gallons: an approximately 2% decrease from Water Year 2007. Central Water District's pumping also decreased slightly in Water Year 2008. CWD pumped 583 acre-feet during Water Year 2008, an approximately 2% decrease from Water Year 2007.

Average groundwater levels in all coastal monitoring wells completed in the Purisima A-unit were slightly lower in Water Year 2008 than Water Year 2007. However, the multi-year groundwater level trend in these wells remains stable or slightly increasing since Water Year 2004.The area near monitoring well SC-1A is an area within the SqCWD service area where the Purisima Formation is believed to be particularly vulnerable to seawater intrusion. Groundwater in well SC-1A levels were maintained above sea level during Water Year 2008, but remained below the estimated protective levels and the average levels were slightly below Water Year 2007 average levels. Water quality in this area confirmed that seawater intrusion is not occurring near this well.

Groundwater levels in monitoring wells SC-10AA and Thurber Lane Deep have shown multi-year declines of varying magnitudes. However, groundwater levels in monitoring wells such as SC-18A and SC-18AA, which are screened in similar hydrogeologic units but are closer to SqCWD pumping wells, do not show similar multi-year declines.

Purisima BC-unit groundwater levels have an overall long-term decline in groundwater levels that are below sea level. However, over the last year, a large portion of the Purisima BC-unit showed a groundwater level rise. Coastal monitoring wells SC-8 and SC-9 groundwater levels increased slightly from the historically low levels observed during Water Year 2007.

Groundwater levels in the Aromas area remained relatively constant throughout Water Year 2008.

Water quality in the western portion of the Purisima Formation , as represented by the SC-1 and SC-3 well clusters, and Main Street well, has a very slowly increasing chloride and TDS trend. Chloride concentrations range from 20 – 48 mg/L, which is well below the drinking water maximum contaminant limit (MCL) of 250 mg/L.

Water quality in the central portion of the Purisima Formation between the Tannery well and SC-5 well cluster has slightly increasing chloride and TDS concentrations at the coast but stable inland concentrations. Chloride concentrations range from 60-70 mg/L, which is well below the MCL of 250 mg/L.

Water quality in the eastern portion of the Purisima Formation from the Estates well to the SC-8 well cluster has slowly increasing chloride and TDS trends at the coast but more stable concentrations inland. Chloride concentrations range from 13-51 mg/L, which is well below the MCL of 250 mg/L. The exception in this area is in the shallowest monitoring well near the mouth of Aptos Creek (well SC-8F) with chloride concentrations of 3,000 mg/L which indicates seawater intrusion.

In the Aromas area, seawater intrusion continues to move inland at well cluster SC-A2 in the Seascape area; and at well cluster SC-A3 in the La Selva Beach area.

Production wells in the Aromas areas have slightly increasing trends in chloride and TDS concentrations but chloride concentrations are less than 40 mg/L, which is well below the MCL of 250 mg/L.

Recommendations for Water Year 2009 include:

1. Further reduce pumping in the Purisima BC-unit.

2. Reassess the adequacy of SqCWD's target pumping goals.

3. Secure a supplemental supply that will help relieve stresses on the basin.

4. Implement the Well Master Plan to redistribute pumping in the basin.

5. Continue to investigate additional water supplies, such as:
   - Recharge,
   - Reclaimed water, and
   - Water demand offset expansion.

6. Manage well operation based on pumping groundwater levels measured by transducers.

7. Continue to upgrade monitoring well network:
   - Replace wells SC-3, SC-8F, SC-9A,
   - Install Polo Grounds monitoring wells, and
   - Upgrade sampling equipment.

8. Survey elevations of monitoring wells that have not been surveyed.

9. Evaluate declining water levels in the Purisima Tu and AA units.

10. Check on all historical results from Soils Laboratory and update database.

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Section 1
INTRODUCTION

Soquel Creek Water District (SqCWD) and Central Water District (CWD) approved a Groundwater Management Plan (GMP) in 2007 (SqCWD and CWD, 2007). Part of the GMP implementation requires preparation of an Annual Review and Report (ARR) following each water year. The ARR summarizes groundwater conditions in the Soquel-Aptos area, documents the status of groundwater management activities, and recommends amendments to the GMP. Under direction of the SqCWD Board of Directors, this Water Year 2008 (October 2007-September 2008) ARR has not been prepared as a stand-alone report, but an update to the full *Water Year 2007 State of the Basin Report* (HydroMetrics LLC, 2009a).

Section 2 of this report summarizes groundwater conditions in the Soquel-Aptos area. As an update to the *Water Year 2007 State of the Basin* Report, this report has limited analysis, but includes representative graphics to present the hydrogeologic condition of the basin. Groundwater level contour maps for Water Year 2008 are not included, but contour maps showing groundwater level changes over one, five, and ten years have been added.

Section 3 documents the status of groundwater management activities. This includes the status of basin management objectives (BMOs) and elements included in the GMP. The status of BMOs assesses whether management activities are meeting the BMOs. Basin management elements are the projects, programs, and policies that are or will be implemented to meet BMOs. The statuses of all elements listed in the GMP are updated. This section also prioritizes elements to achieve BMOs and includes recommendations for future updates to the ARR. There are no recommendations for revisions to the GMP this year.

This report is reviewed by the Groundwater Management Plan Basin Advisory Group (BAG), which provides both technical expertise necessary to guide implementation of groundwater management, and a forum for interagency coordination. The BAG consists of the Soquel Aptos Groundwater Management Alliance (SAGMA) and the Pajaro Valley Water Management Agency. After comments from the BAG are incorporated in the report, the report is presented to the Basin Implementation Group (BIG) for approval. The BIG comprises representatives of SqCWD and CWD as designated in the Joint Exercise of Powers Agreement (JPA) between the two agencies. However, the JPA will need to be revised to officially cover implementation of the GMP, including this ARR.

Section 2
WATER YEAR 2008 UPDATED TRENDS AND CONDITIONS IN THE SOQUEL-APTOS GROUNDWATER MANAGEMENT AREA

This section presents the current status of groundwater in the Soquel-Aptos area. Historical trends for representative wells are presented for both groundwater levels and groundwater quality. Changes in groundwater levels over one, five and ten-year periods are also depicted in contour maps. Current and historical groundwater pumping are presented, and groundwater pumping is compared to the sustainable yield numbers of Johnson et al. (2004).

2.1 WATER YEAR 2008 PRECIPITATION

SqCWD collects rainfall data from two gauges in the Soquel-Aptos area: the Mancarti gauge and the Kraeger gauge. Data loggers record rainfall at these gauges at 15-minute intervals. Precipitation at the Mancarti and Kraeger gauges during Water Year 2008 was 28.12 and 27.99 inches respectively. These rainfall totals were well below the average values of 36.60 inches at the Mancarti gauge and 37.67 inches at the Kraeger gauge measured between Water Year 1984 and Water Year 2008. Precipitation for Water Year 2008 for both locations was approximately 75% of the annual average precipitation. Water Year 2008 precipitation at the Mancarti gauge was the eighth lowest recorded precipitation over the period of record, beginning in Water Year 1984. Water Year 2008 precipitation at the Kraeger gauge was the ninth lowest recorded precipitation over the period of record, beginning in Water Year 1984. Annual precipitation totals by Water Year for both gauges are presented in Figure 1.

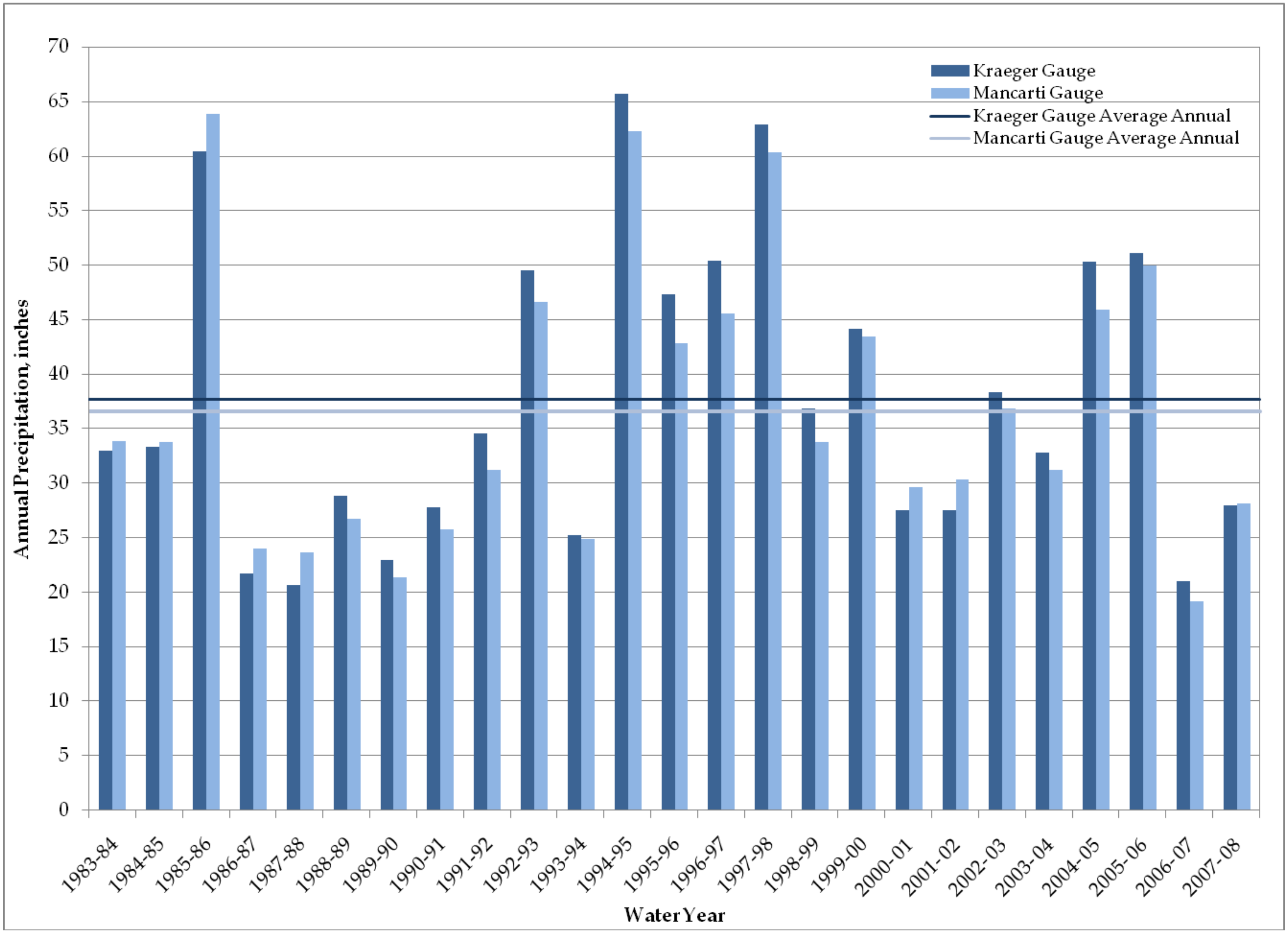

Figure 1: Precipitation at Kraeger and Mancarti Gauges

2.2 GROUNDWATER LEVELS

Selected hydrographs are presented in this section. The hydrographs are selected to illustrate groundwater level trends in representative parts of the groundwater basin for different aquifer units; and to allow comparison of groundwater levels in different aquifer units at a single location. A complete set of groundwater level data for all wells is available on CD with this report.

Spatial changes in groundwater levels are presented as a set of contour maps for selected hydrostratigraphic units for both April and October. Changes in groundwater levels are included over one, five and ten year periods.

2.2.1 PURISIMA AREA GROUNDWATER LEVELS

Representative hydrographs are presented to provide an overview of groundwater level trends in the Purisima Formation. A complete set of groundwater level data for the Purisima Formation monitoring and production wells are included with this report on CD. The hydrographs include a line showing the protective groundwater levels calculated in the *Groundwater levels to protect against seawater intrusion and store freshwater offshore* report (HydroMetrics LLC, 2009b). The locations of SqCWD and City of Santa Cruz production wells and monitoring wells in the Purisima Formation are shown in Figure 2 for Purisima A-unit and Figure 3 for Purisima BC-unit. Hydrographs of the SC-1, SC-8, SC-9, and SC-17 monitoring well clusters are shown in Figure 4 through Figure 8.

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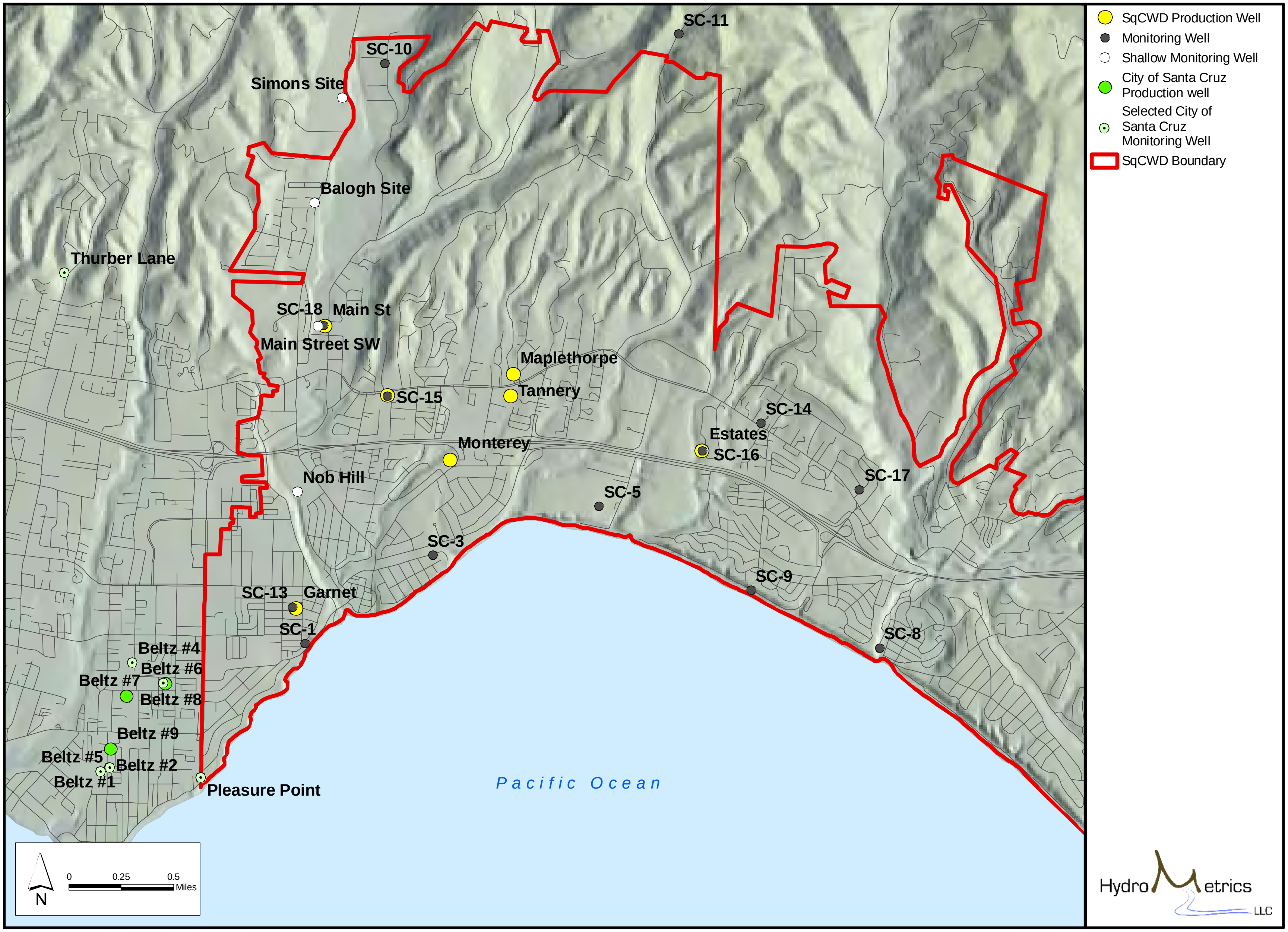

Figure 2: Purisima A-Unit and AA-Unit Wells

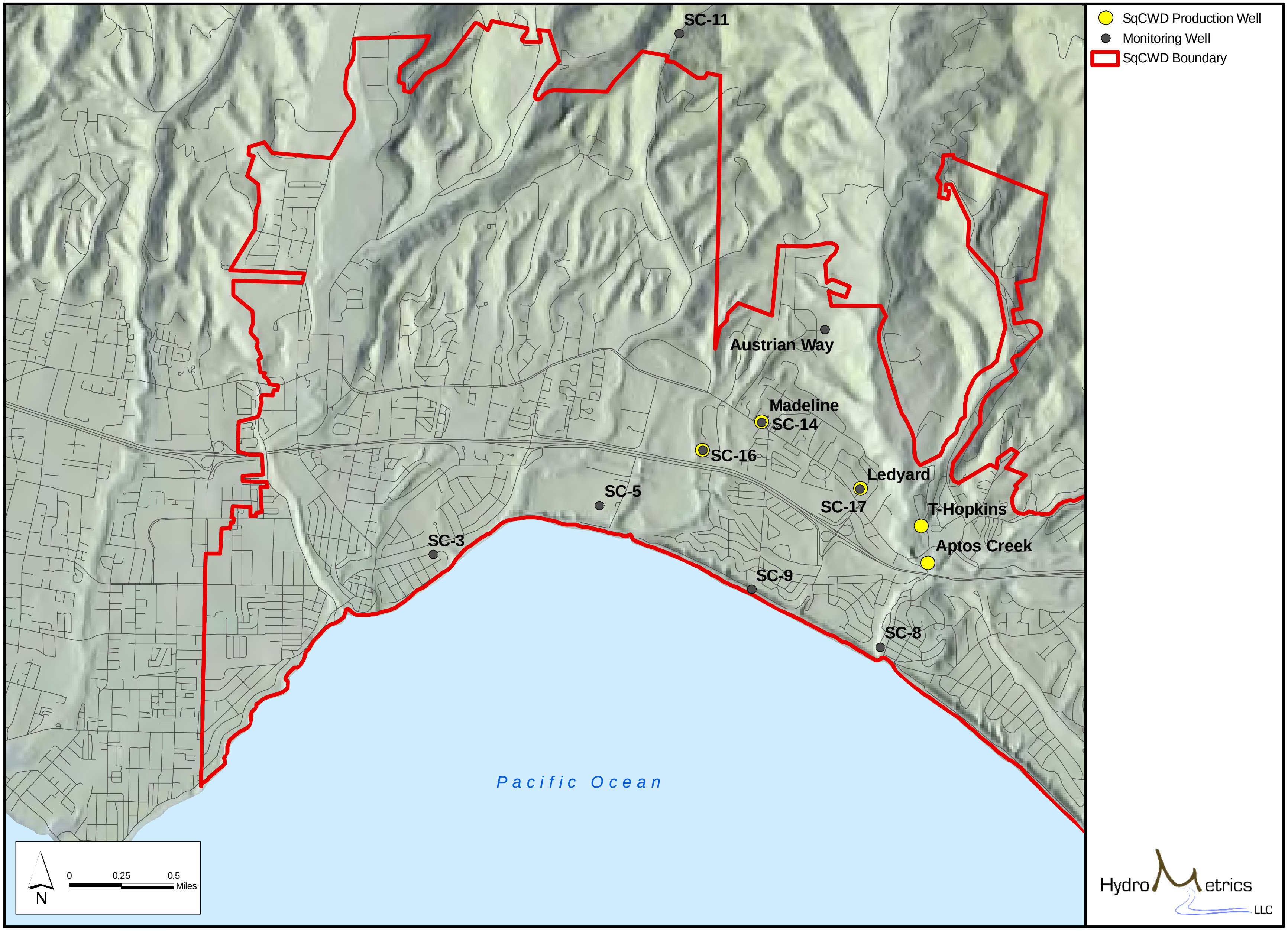

Figure 3: Purisima BC-Unit and DEF-Unit Wells

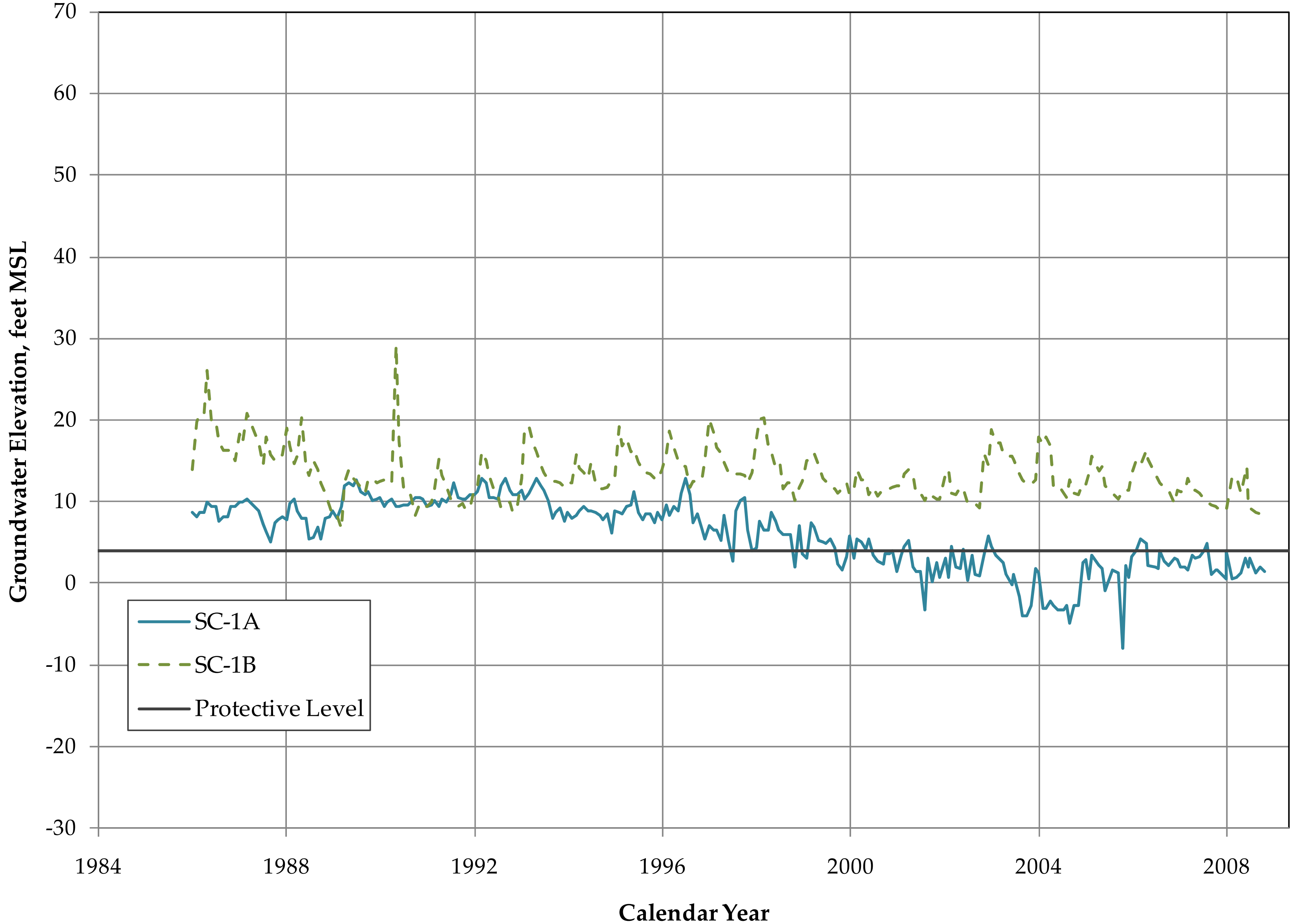

Figure 4: Monitoring Well Cluster SC-1 Hydrographs

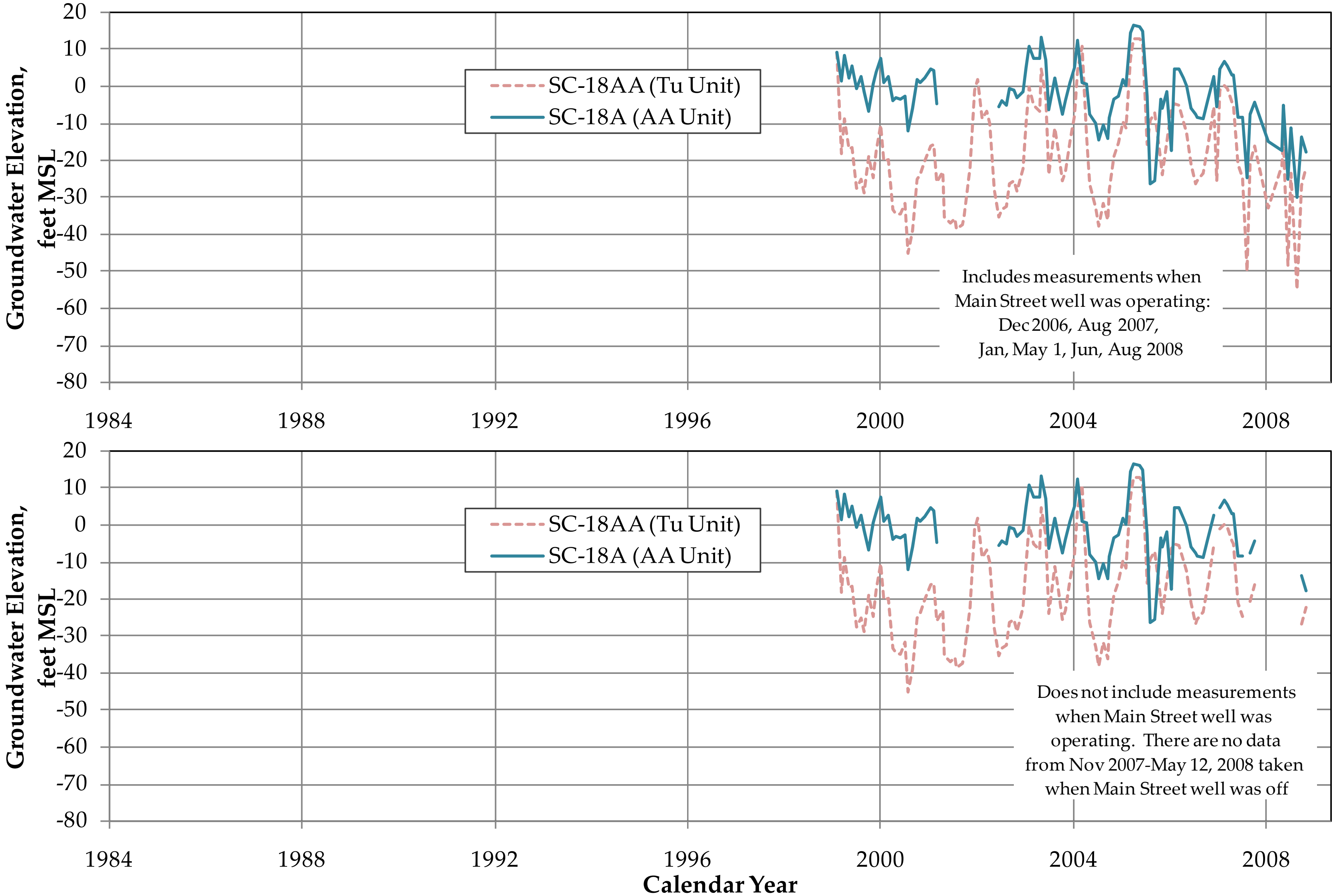

Figure 5: Monitoring Well Cluster SC-18 Hydrographs

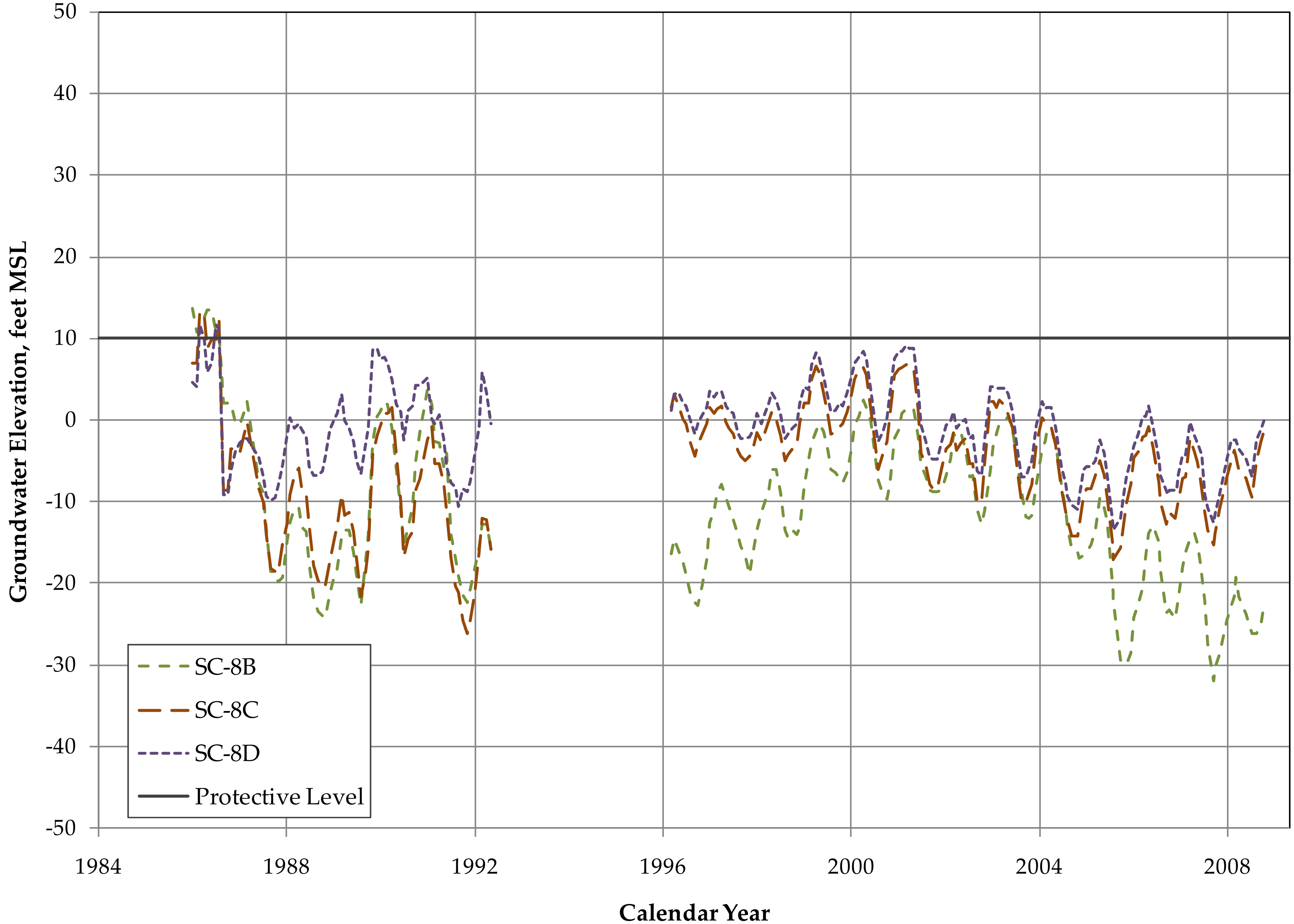

Figure 6: Monitoring Well Cluster SC-8 Hydrographs

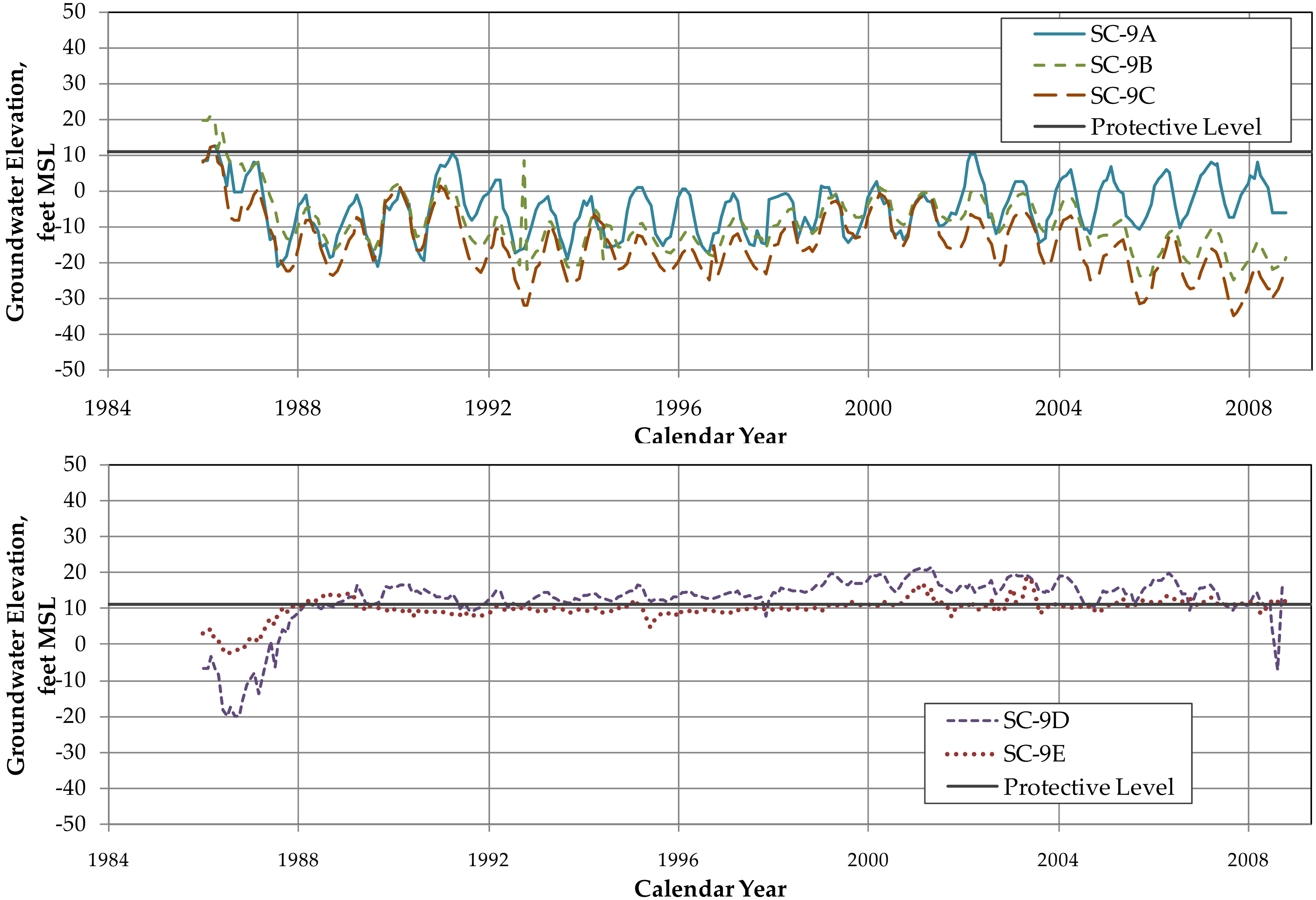

Figure 7: Monitoring Well Cluster SC-9 Hydrographs

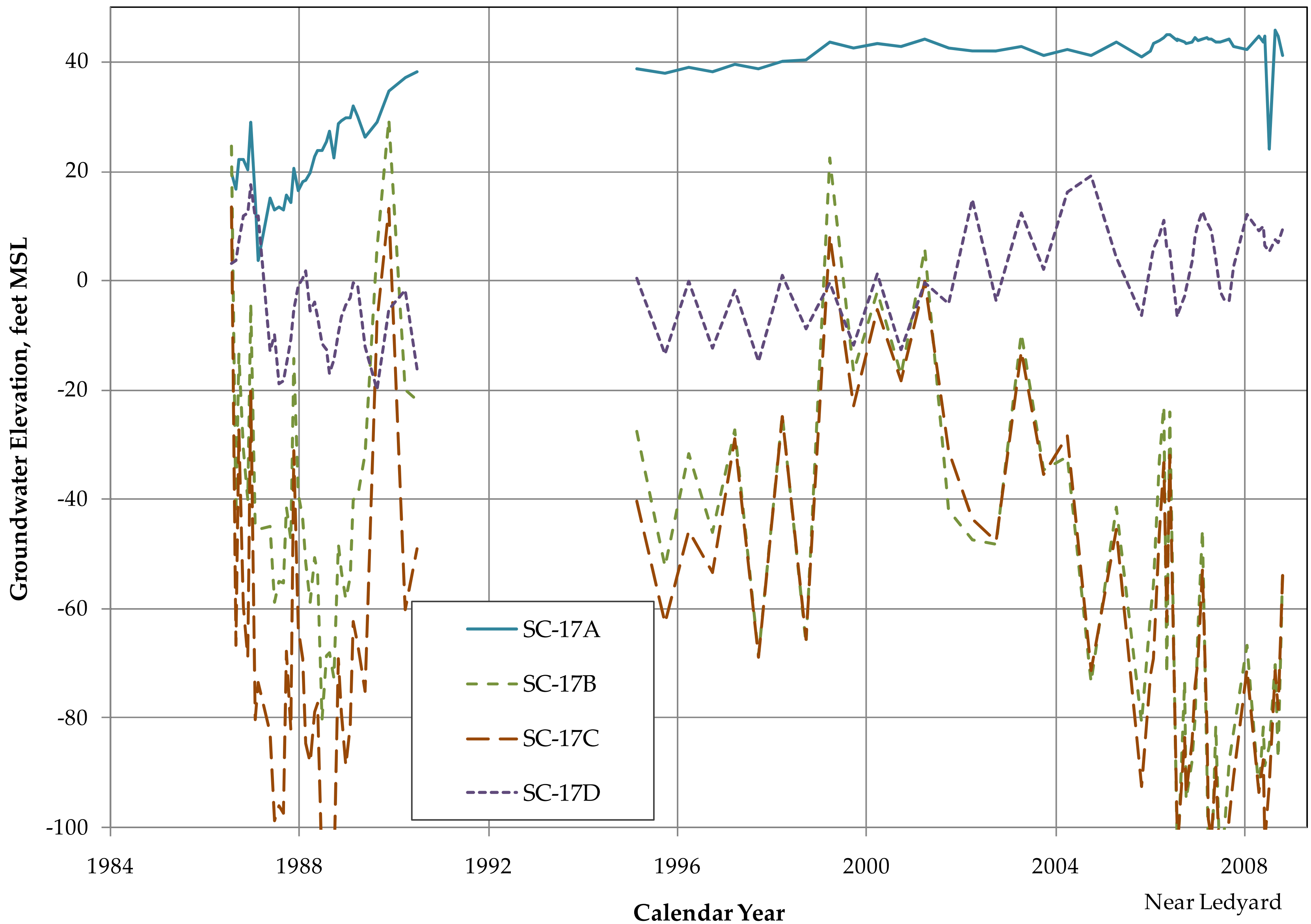

Figure 8: Monitoring Well Cluster SC-17 Hydrographs

Hydrographs from monitoring wells SC-1A and SC-1B are shown in Figure 4. Monitoring well cluster SC-1 is located approximately four blocks from the Garnet well. This area is considered to be at risk for intrusion due to exposure of the Purisima A-unit on the nearby seafloor. The hydrograph for well SC-1A shows groundwater levels decreasing starting in 1993 and dropping below sea level in 2003 to historically low levels. Groundwater levels then rose back above sea level in 2005, in response to SqCWD managing the pumping at the Garnet well. Groundwater levels have continued to remain above sea level during Water Year 2008, but remain below the level modeled as protective against seawater intrusion (HydroMetrics LLC, 2009b). Groundwater levels in other Purisima A-unit coastal monitoring wells near A-unit production wells (SC-3A and SC-5A) are similarly below protective levels. The hydrograph for monitoring well SC-1B represents groundwater levels in the shallower Purisima B-unit where levels have declined very slightly since 2007 but remain more than 10 feet above sea level. The highest groundwater levels measured in monitoring well SC-1B during Water Year 2008 were higher than Water Year 2007 groundwater levels, but were still lower than the high water levels measured between 2003 and 2006.

Groundwater levels in inland monitoring well SC-10AA, completed in the Purisima AA unit, have slightly declined since 2002 (hydrograph on CD). The decline during that time has been between 5 and 10 feet. The historical low groundwater level was measured in Water Year 2008. SqCWD's Main Street well extracts some of its flow from the Purisima AA unit, and has been suggested as the cause of this groundwater level decline. However, groundwater levels in monitoring well SC-18A, adjacent to the Main Street well and screened in the Purisima AA unit, do not show a multi-year decline since 2002 (Figure 5). Four of the eight groundwater levels measured at SC-18A during Water Year 2008 were taken while the Main Street well was pumping. As a result, groundwater level data from this well were biased low in Water Year 2008 and do not indicate a groundwater level decline.

A multi-year groundwater level decline is also observed in the Tu unit underlying the AA unit. Groundwater levels in the City of Santa Cruz's Thurber Lane Deep monitoring well, which is screened in the underlying Tu unit below the Purisima Formation, have declined over 50 feet since 2005 (see hydrograph on CD). SqCWD's Main Street well extracts much of its flow from the Tu unit, and has been suggested as the cause of this groundwater level decline. However, similar to the Purisima AA unit discussed above, groundwater levels in monitoring well SC-18AA, adjacent to the Main Street well and screened in the Tu unit, do not show a multi-year decline since 2004 (Figure 5). Four of the eight groundwater levels measured at SC-18AA during Water Year 2008 were taken while the Main Street well was pumping. As a result, groundwater level data from this well were biased low in Water Year 2008 and do not indicate a groundwater level decline.

Hydrographs from monitoring wells SC-8B, SC-8C, and SC-8D are shown in Figure 6. Well cluster SC-8 is located near the mouth of Aptos Creek. Groundwater levels in the SC-8B, SC-8C, and SC-8D wells show downward trends since 2001, are below the protective level, and are currently also below sea level. In Water Year 2008, the lowest groundwater levels observed in wells SC-8B, SC-8C and SC-8D did not drop as far as the lowest groundwater levels observed during Water Year 2007. This was probably due to the cessation of pumping at the Aptos Creek well from July to October 2008. Also of note is that the groundwater levels in well SC-8B, completed in the BC-unit, are lower than the groundwater levels in the shallower SC-8C and SC-8D well completions. As the nearest production wells to the SC-8 monitoring wells are the shallower DEF-unit Aptos Creek and T-Hopkins wells, the drawdown in well SC-8B must be due to farther away BC-unit production wells. This would suggest that drawdown caused by production wells in the BC-unit spreads farther and deeper than drawdown in the DEF-unit.

Hydrographs from the SC-9 monitoring well cluster are shown in Figure 7. Well cluster SC-9 is located along the coast in the Seacliff area. Hydrographs from the deeper monitoring wells (SC-9A, SC-9B, and SC-9C) continue to show relatively large annual fluctuations compared to the hydrographs of the shallower SC-9D and SC-9E wells. Groundwater levels in the BC-unit (SC-9B, and SC-9C) are trending downward, are below the protective level, and are approaching historically low levels. Groundwater levels measured in well SC-9A remain similar to levels measured in the previous Water Year. The nearest production well, the Estates well, is mostly completed in the Purisima A-unit but is also partially completed in the Purisima BC-unit. This partial BC-unit completion and the proximity of the Madeline and Ledyard wells which are completed in the BC-unit result in a larger drawdown in the BC-unit than the A-unit.

Some of the lowest groundwater levels in the Soquel Aptos Basin are in the BC-unit of the Purisima Formation. These low groundwater levels are observed in the hydrographs from the SC-17 monitoring well cluster, shown in Figure 8.

Well cluster SC-17 is located adjacent to the Ledyard well. The SC-17 well cluster is further inland than the SC-8 and SC-9 monitoring well clusters, and closer to active production wells. Consequently, these wells show much larger seasonal fluctuations in response to pumping than observed in the SC-8 and SC-9 monitoring well clusters. Water Year 2008 groundwater levels in wells SC-17B and SC-17C have increased from the historically low groundwater levels observed during Water Year 2007, but still remain well below sea level. They also exhibit the same decreasing trend observed in the coastal Purisima BC-Unit cluster wells at SC-8 and SC-9.

Purisima Formation Groundwater Level Change Maps

Contour maps showing differences in groundwater elevations between Water Years 2008 and 2007 (one year), Water Years 2008 and 2003 (five years), and Water Year 2008 and 1998 (ten years) were created for the Purisima A-unit and BC-unit for both April and October. These groundwater level difference contours provide an indication of how groundwater levels have changed over time in the Purisima Formation.

Groundwater level change contour maps are shown in Figure 9 through Figure 14 for the Purisima A-unit, and Figure 15 through Figure 20 for the Purisima BC-unit. Hatched contour lines represent a decrease in groundwater levels, while unhatched contour lines represent an increase in groundwater levels. The background colors on the maps show a decline in groundwater levels as red shades and an increase in groundwater levels as green-blue shades.

Variability in individual well pumping often produce groundwater level anomalies that overwhelm the actual groundwater level trends. Several issues may distort the difference calculations near production wells.

- The production well may not be producing in both of the months being compared. This results in a large calculated difference as water levels near the production well are low in the month when the well is producing and high in the month when the well is not producing.
- Water levels in monitoring wells near production wells may be recorded when the production well is pumping. If this water level is compared to water levels in monitoring wells when the production well is not pumping, a large calculated difference is the result.

- Static water levels in production wells are sometimes measured a short time after the production well is turned off. These water levels may be lower than measurements taken after a longer recovery period, and comparing two such measurements results in a large calculated difference.

In order to account for these potential issues, the hydrographs on the accompanying CD were used in conjunction with the difference contour maps to describe the short-term (one-year) and long-term (five- and ten-year) trends. For purposes of our evaluation, we consider a ± 5 foot change as being somewhat stable and within the range that does not need to be justified.

PURISIMA A-UNIT GROUNDWATER LEVEL CHANGE

A review of both the hydrographs and the difference contours for the Purisima A-unit (Figure 9 through Figure 14) show that the long-term groundwater level trends in this aquifer are mostly increasing. The Estates well is the only location where groundwater levels have been decreasing over the last ten years. These same trends have generally continued over the last year (Figure 9 and Figure 12).

The contour maps shown in Figure 9 through Figure 14 are distorted by anomalous levels at the Tannery II and Rosedale wells. Monthly pumping fluctuations at both these wells resulted in groundwater changes that do not reflect the long-term trends in these wells.

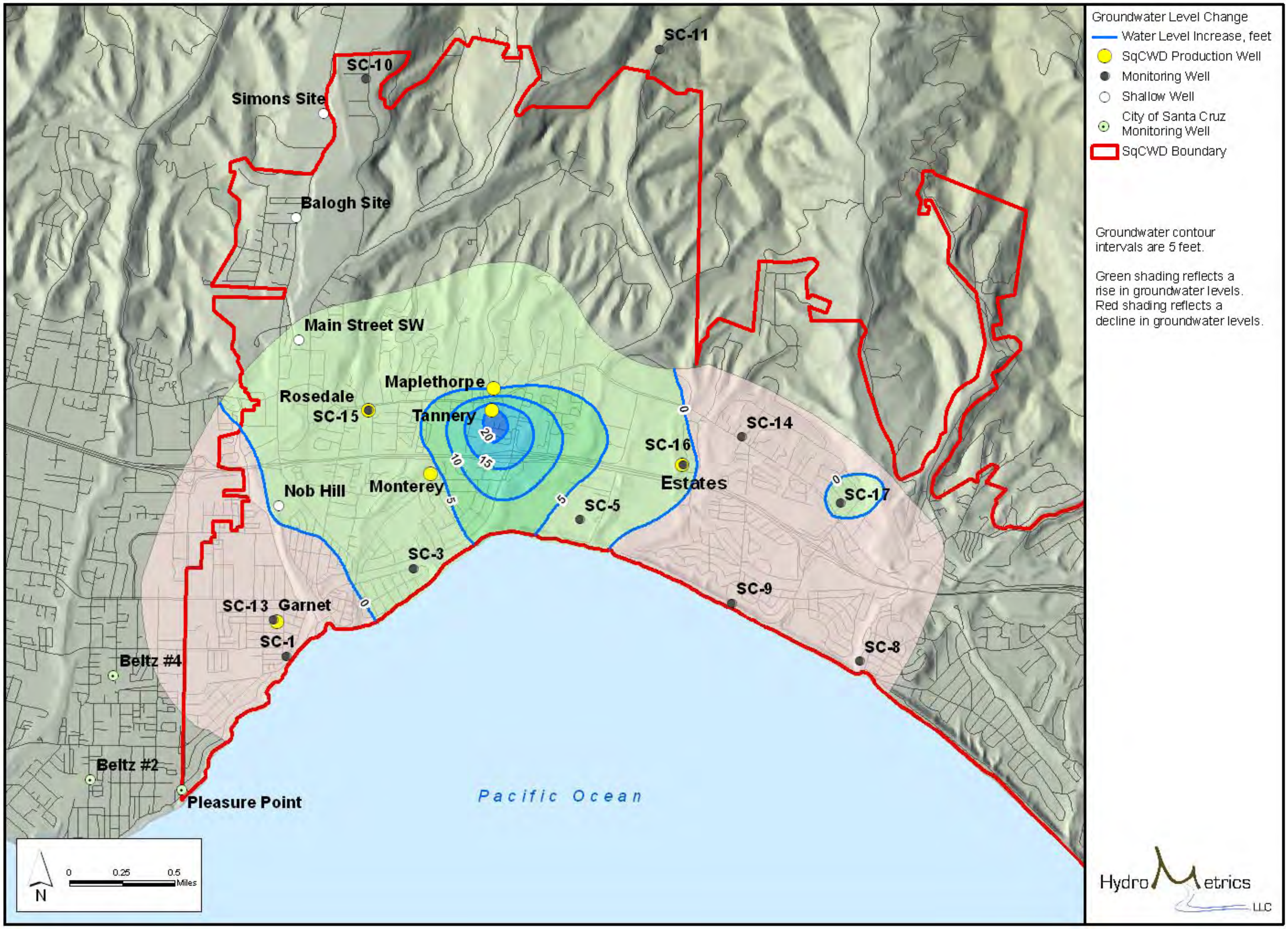

Figure 9: One Year Water Level Changes, Purisima A-Unit, April 2008 – April 2007

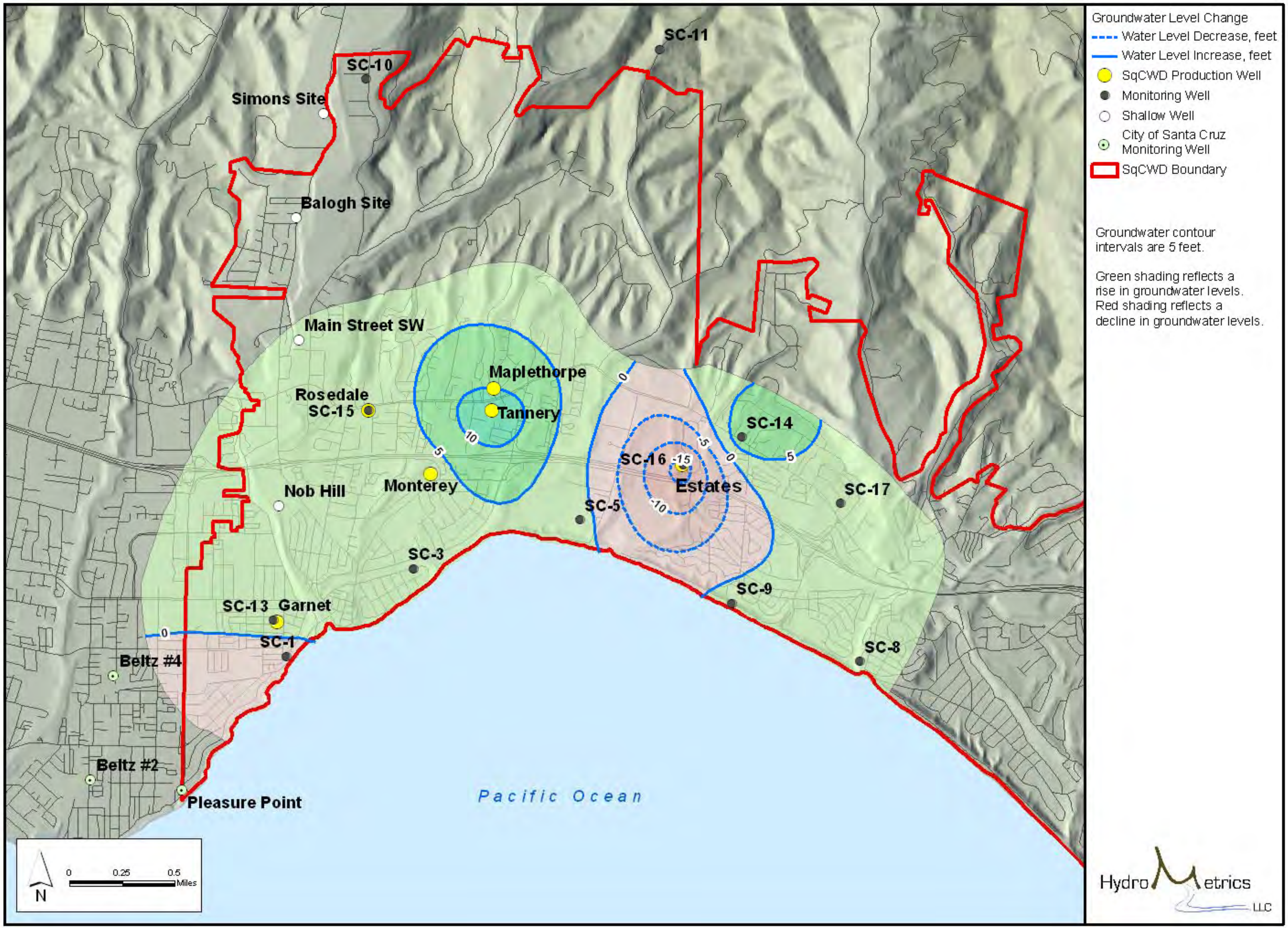

Figure 10: Five Year Water Level Changes, Purisima A-Unit, April 2008 – April 2003

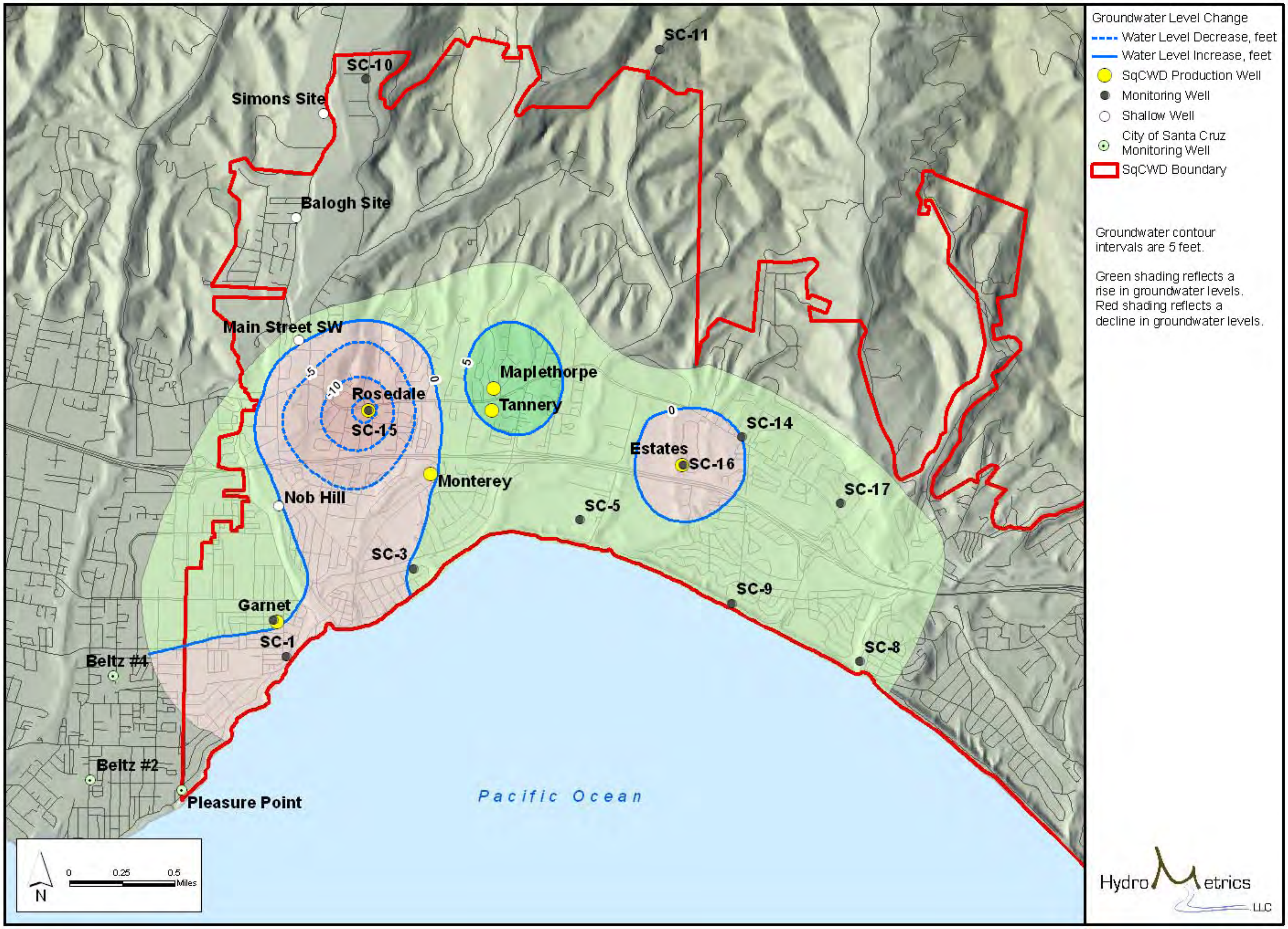

Figure 11: Ten Year Water Level Changes, Purisima A-Unit, April 2008 – April 1998

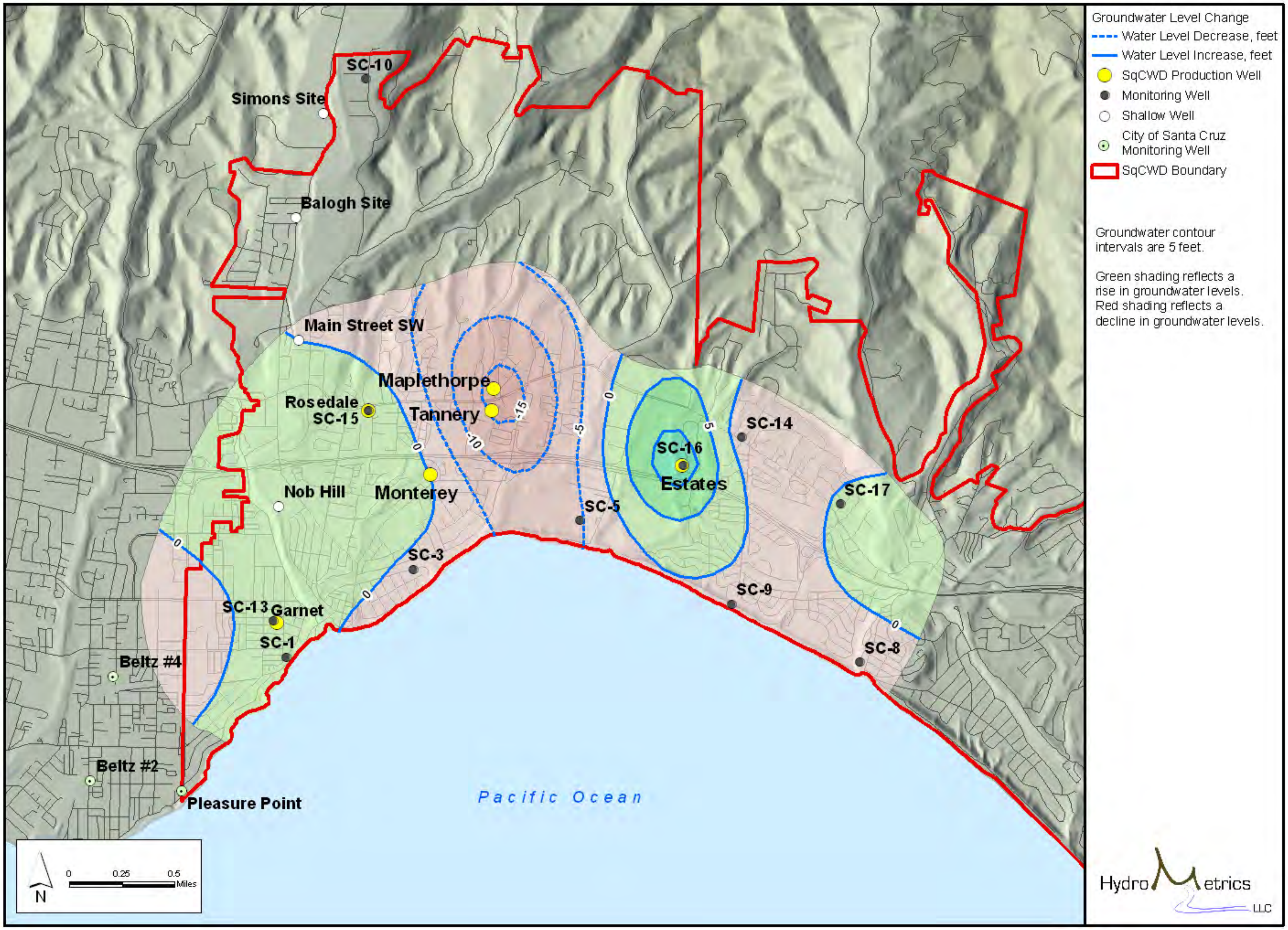

Figure 12: One Year Water Level Changes, Purisima A-Unit, October 2008 – October 2007

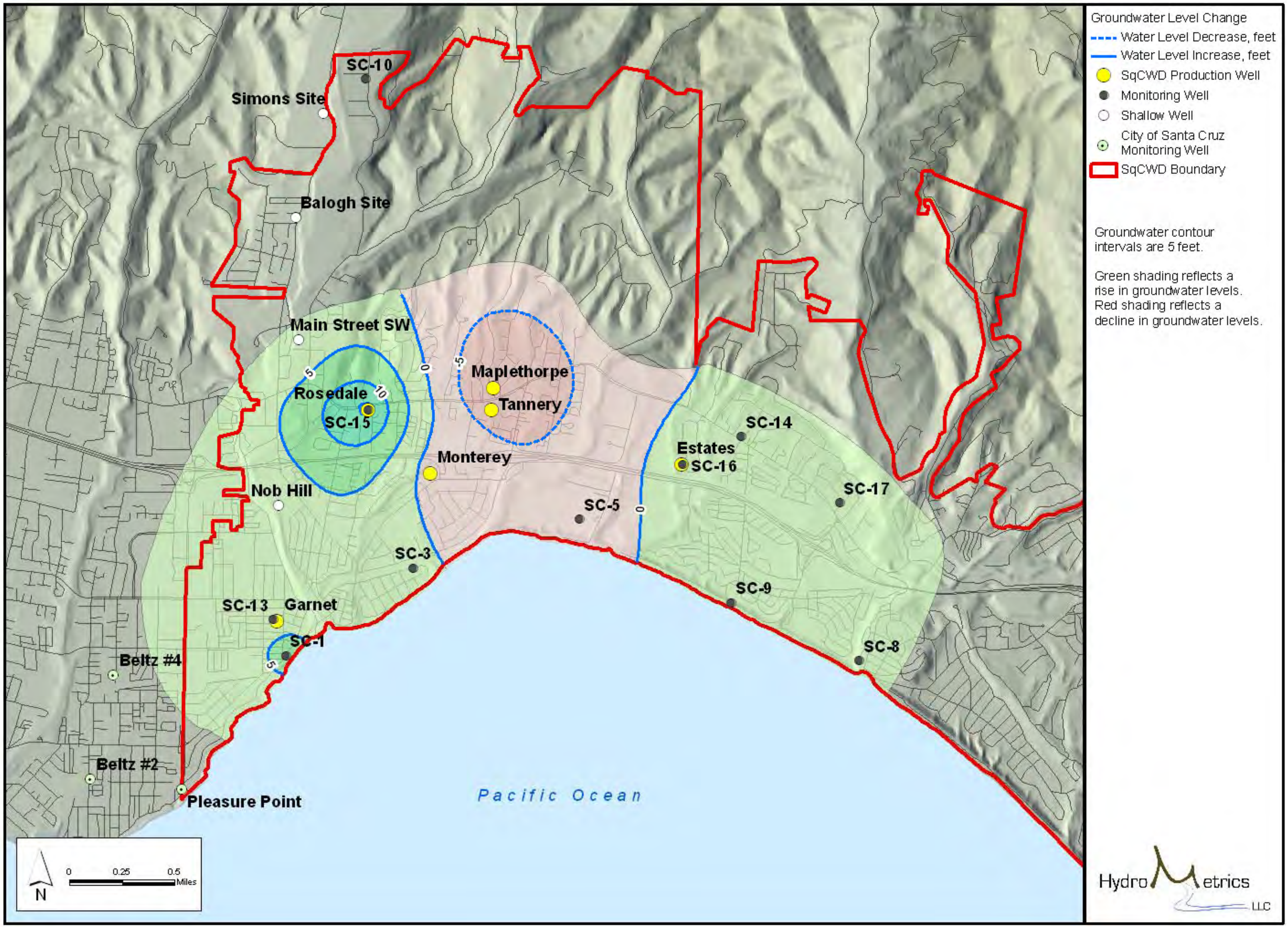

Figure 13: Five Year Water Level Changes, Purisima A-Unit, October 2008 – October 2003

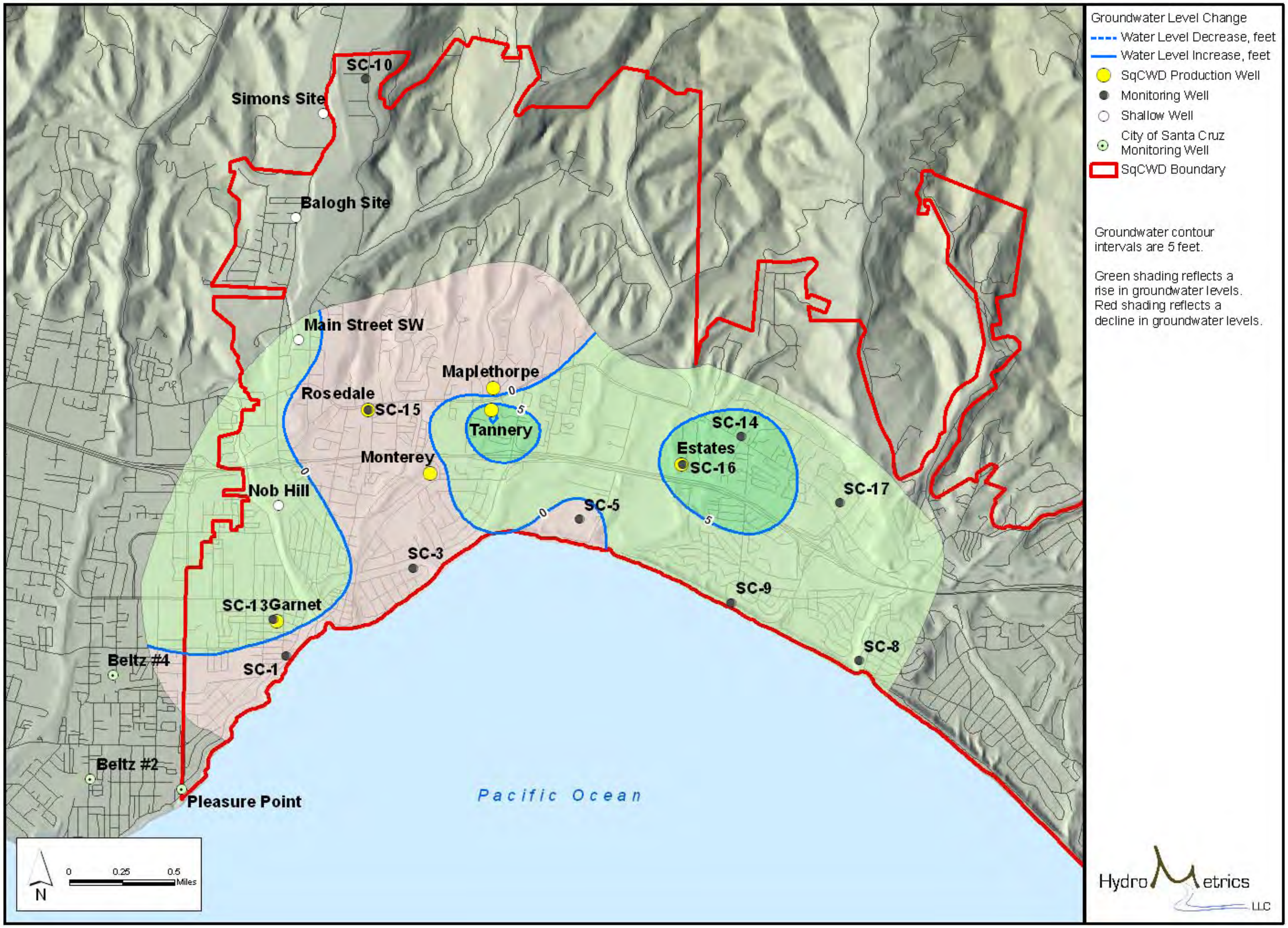

Figure 14: Ten Year Water Level Changes, Purisima A-Unit, October 2008 – October 1998

PURISIMA BC-UNIT GROUNDWATER LEVEL CHANGE

In the shallower Purisima BC-unit, the hydrographs and groundwater level change maps (Figure 15 through Figure 20) show an overall long-term decline in groundwater levels throughout the unit, although over the last year a large portion of the Purisima BC-unit showed a groundwater level rise (Figure 15 and Figure 18). The area of greatest increase over the past year was the portion of the aquifer between the Madeline and T-Hopkins wells. Reduced pumping from January to April 2008 in the production wells in this area explains the rise in groundwater around those wells. Decreases substantially greater than 5 feet on the one-year difference maps, such as at the Estates well in Figure 15, are attributable to monthly pumping fluctuations that do not reflect long-term trends.

Over the long-term (five- to ten-years), the entire Purisima BC-unit except around monitoring well SC-5 has decreasing groundwater levels. Increases substantially greater than 5 feet on the long-term difference plots, such as at the Ledyard well in Figure 20, are attributable to monthly pumping fluctuations that do not reflect long-term trends.

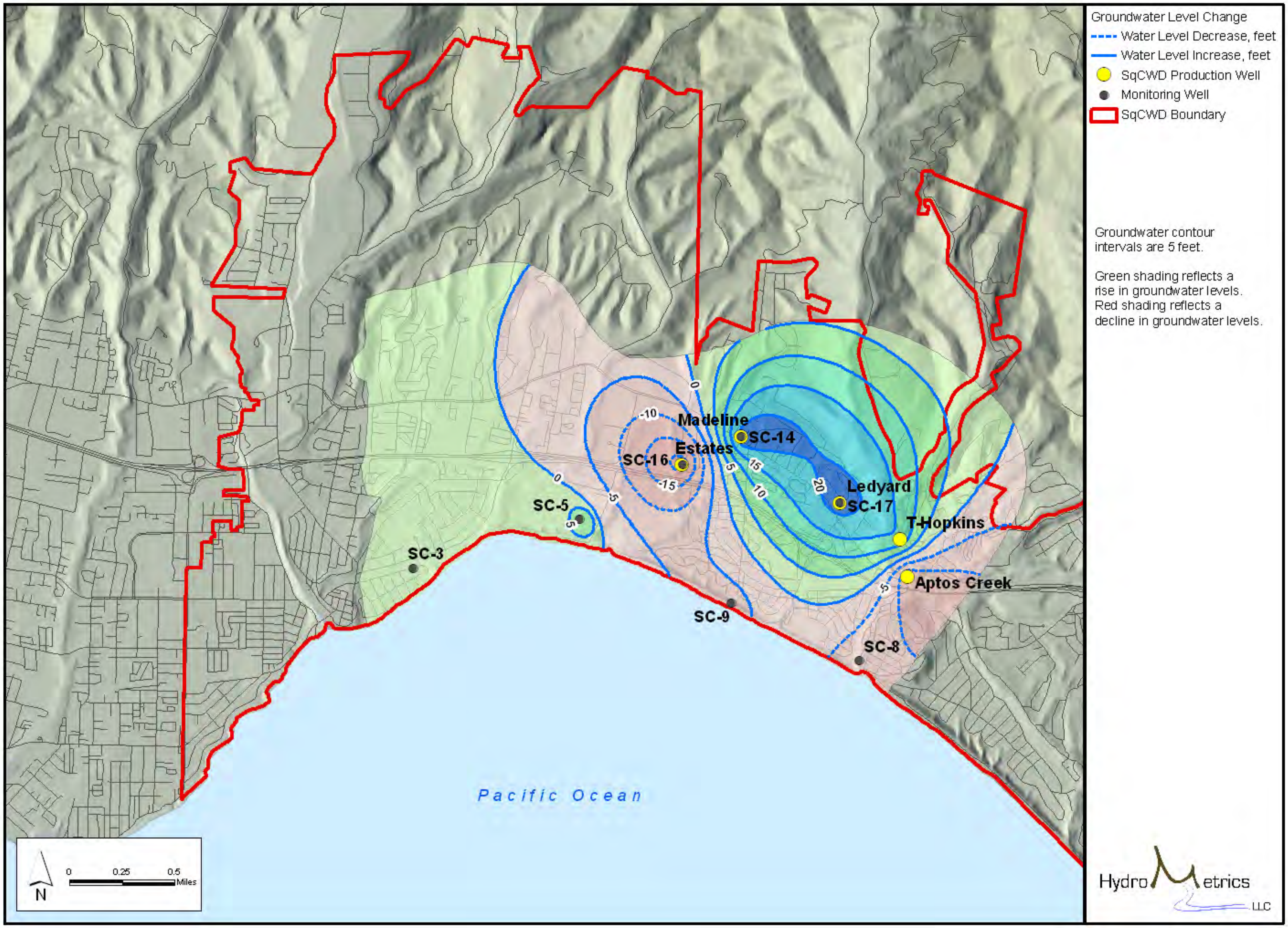

Figure 15: One Year Water Level Changes, Purisima BC-Unit, April 2008 – April 2007

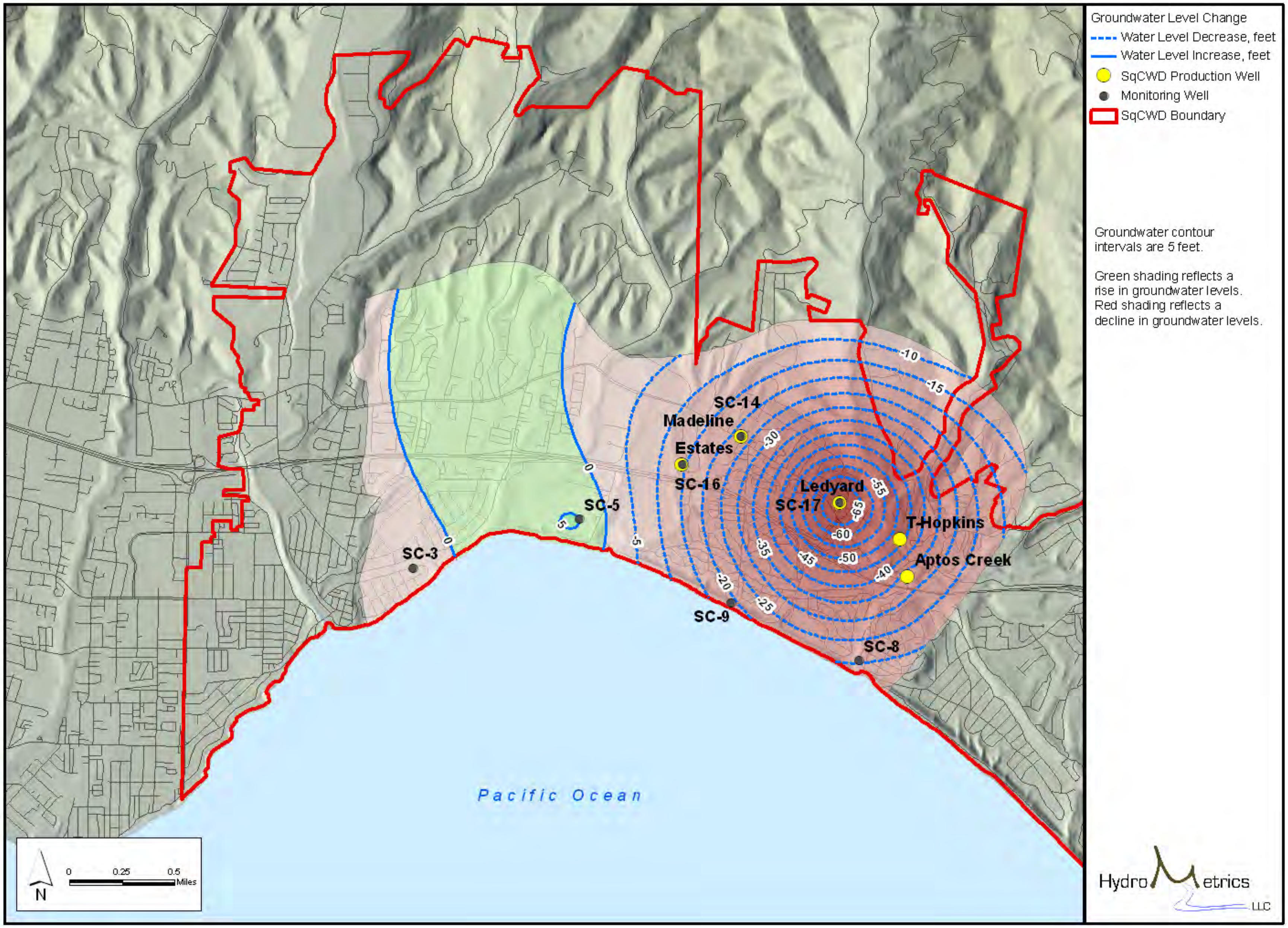

Figure 16: Five Year Water Level Changes, Purisima BC-Unit, April 2008 – April 2003

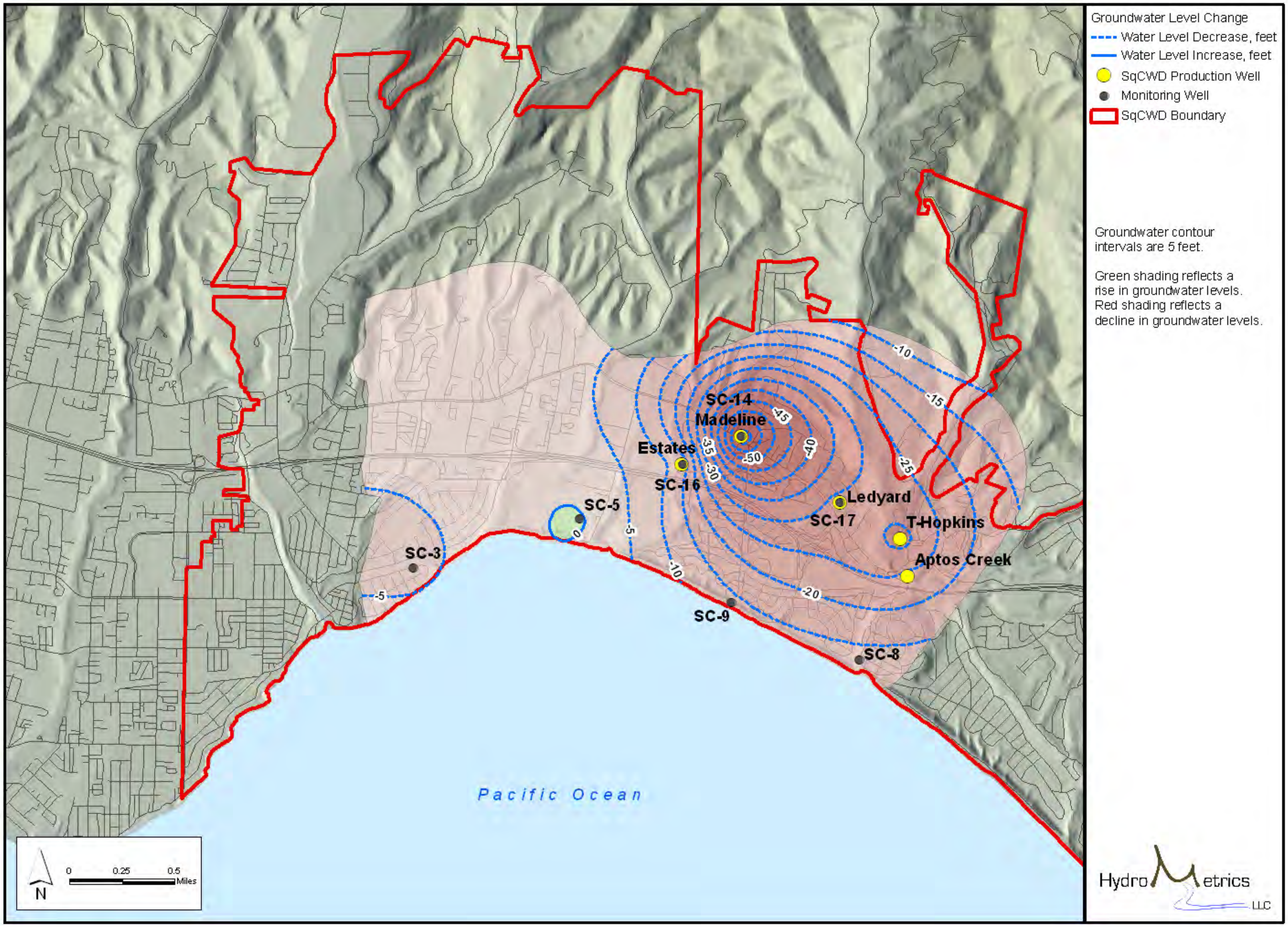

Figure 17: Ten Year Water Level Changes, Purisima BC-Unit, April 2008 – April 1998

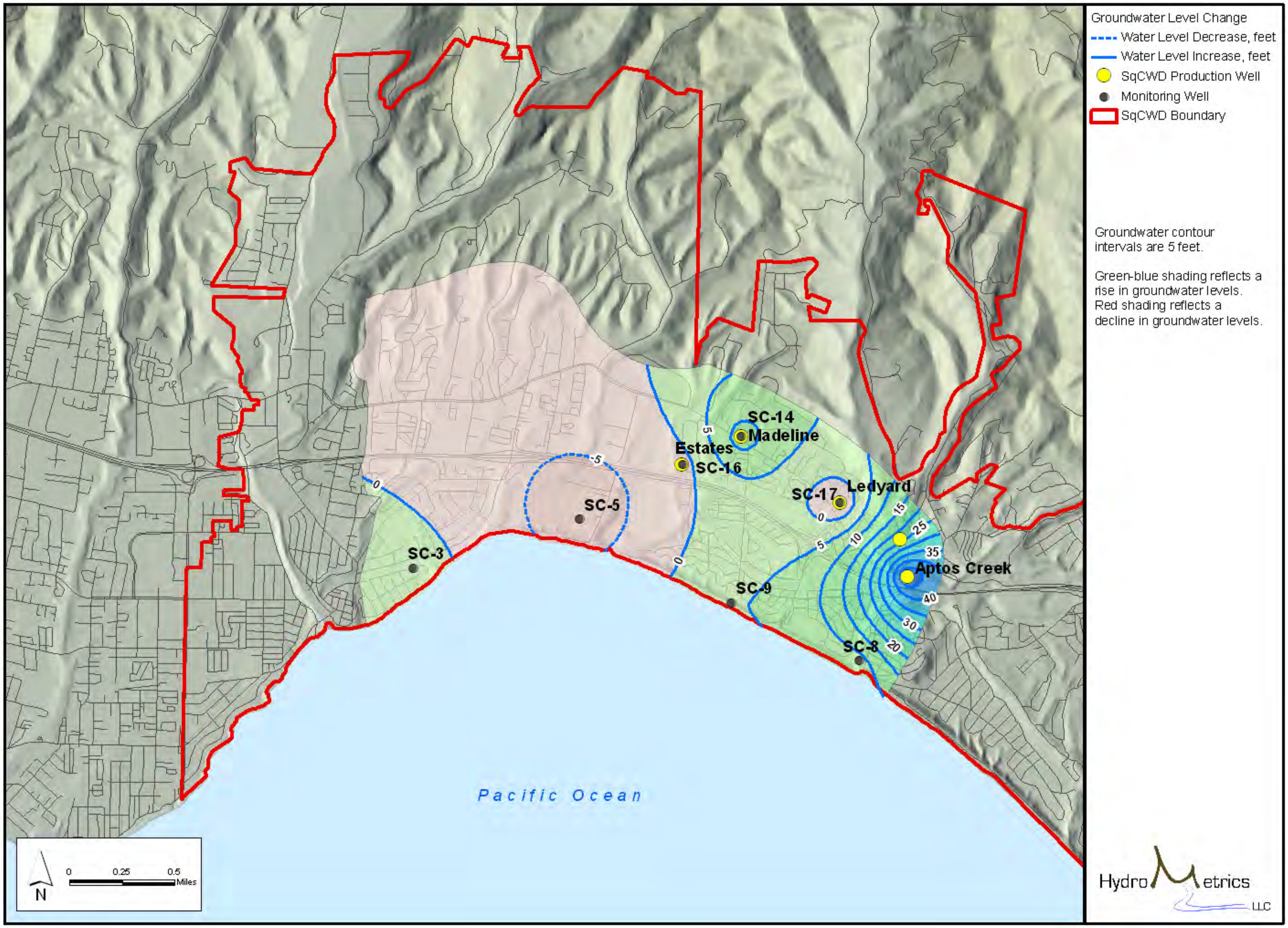

Figure 18: One Year Water Level Changes, Purisima BC-Unit, October 2008 – October 2007

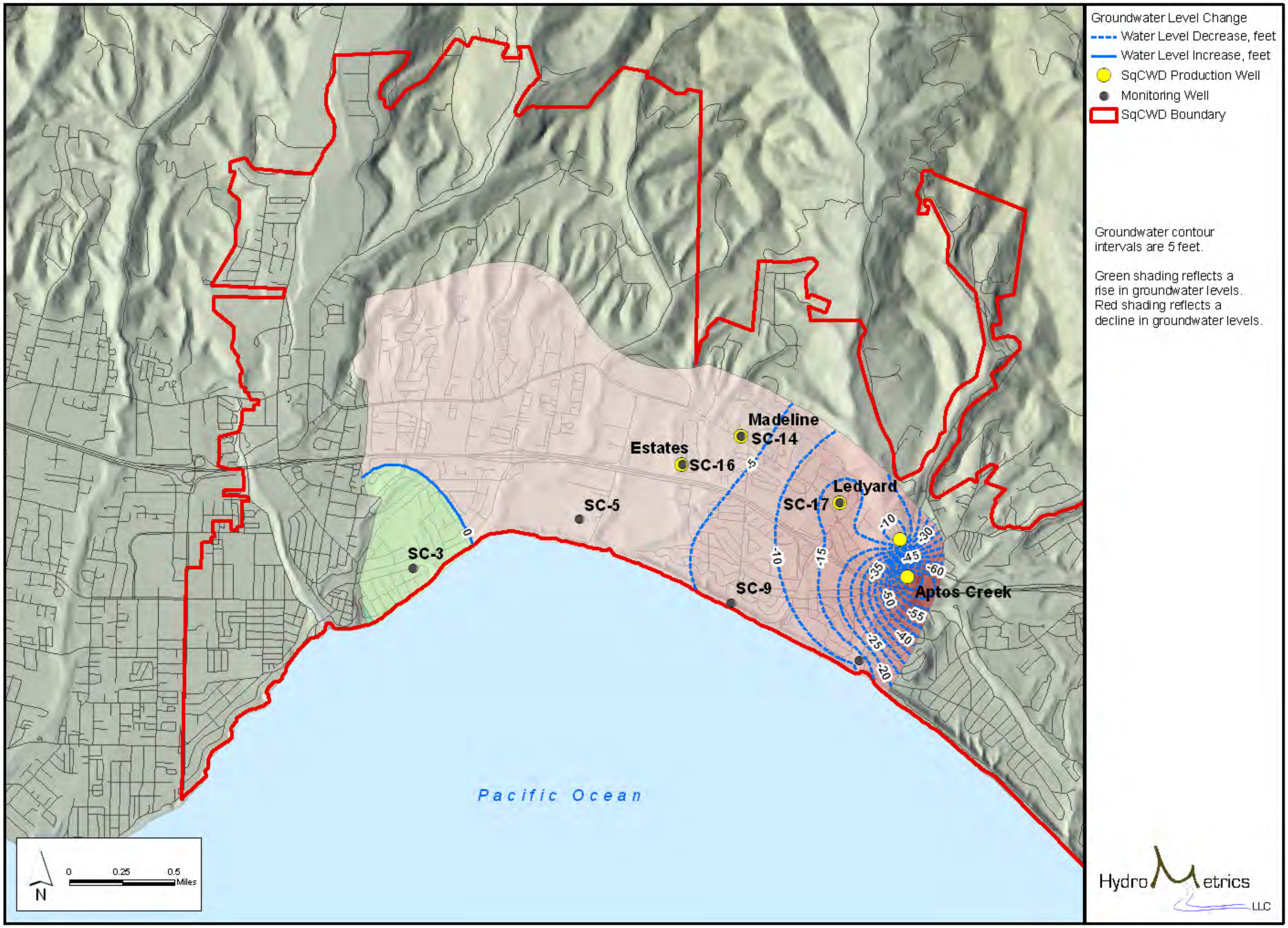

Figure 19: Five Year Water Level Changes, Purisima BC-Unit, October 2008 – October 2003

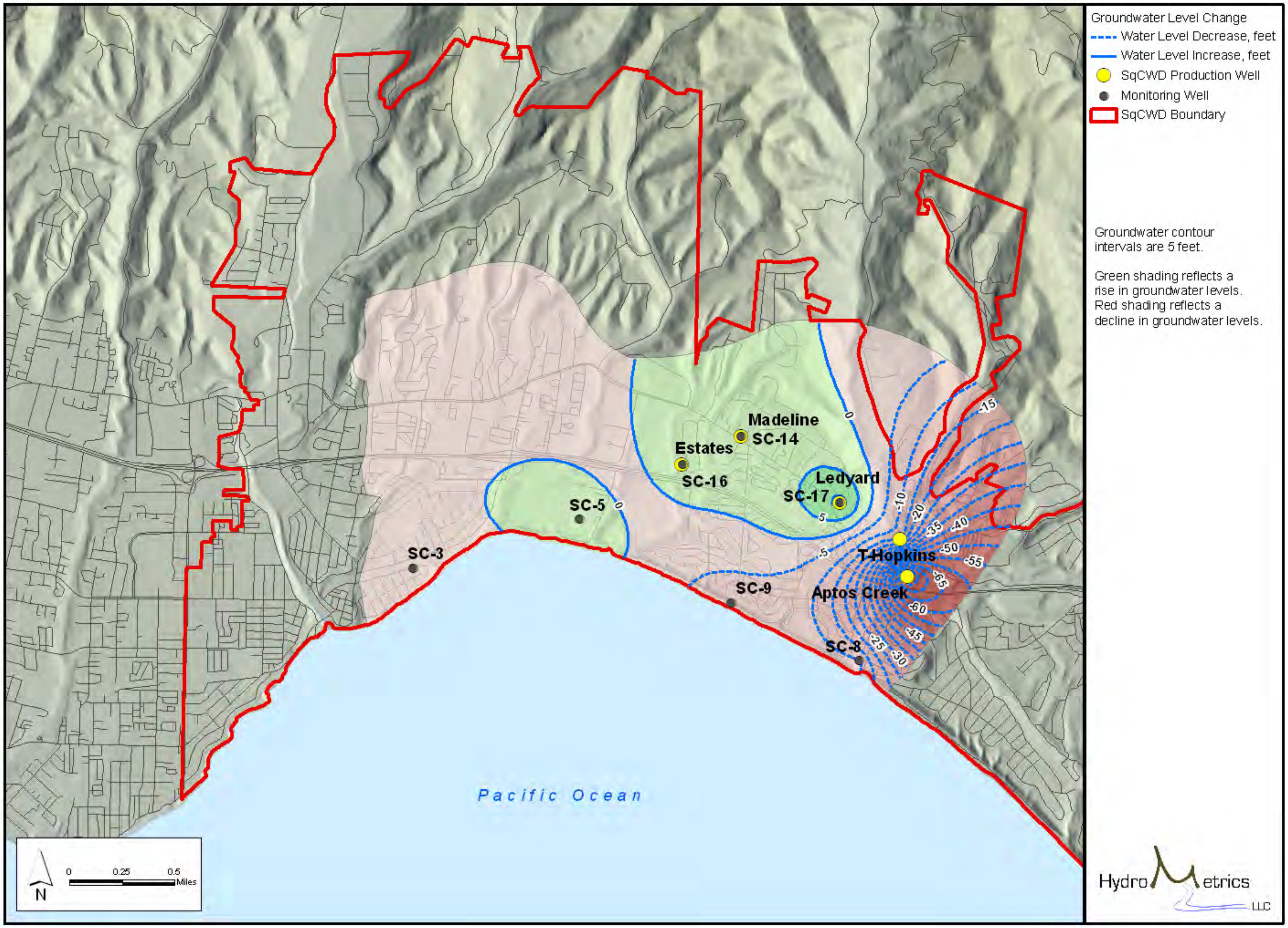

Figure 20: Ten Year Water Level Changes, Purisima BC-Unit, October 2008 – October 1998

2.2.2 AROMAS AREA GROUNDWATER LEVELS

Representative hydrographs are presented here to provide an overview of groundwater level trends in the Aromas area. A complete set of groundwater level data for the Aromas area monitoring and production wells are included in a CD that accompanies this update report. The hydrographs include a line showing the protective groundwater levels calculated in the *Groundwater levels to protect against seawater intrusion and store freshwater offshore* report (HydroMetrics LLC, 2009b). The locations of all SqCWD and CWD production and monitoring wells in the Aromas area are shown in Figure 21.

Hydrographs from the SC-A2 monitoring well cluster are shown in Figure 22. Well cluster SC-A2 is located along Sumner Drive in the southern Rio Del Mar area. Groundwater levels in each of the three monitoring wells at this site are above sea level. The groundwater levels in all three monitoring wells are relatively similar, indicating less hydraulic separation of units than observed in the Purisima Formation. Current groundwater levels in the SC-A2 monitoring well cluster are between 3 and 7 feet above mean sea level. Water levels in this cluster generally remained fairly stable over the past year, and have slightly increased since 2004, but are still below the protective level.

Hydrographs from the SC-A4 monitoring well cluster are shown in Figure 23. Well cluster SC-A4 is the southernmost monitoring well cluster, located in the Cañon del Sol area. Groundwater levels in the SC-A4B, SC-A4C, and SC-A4D completions (upper aquifers) are relatively similar, apparently acting as a single hydrogeologic unit. All groundwater levels are above sea level, but are approximately 5 feet below protective levels.

The Aptos Jr. High well was reactivated by SqCWD in March 2007, after being inactive since 1986. This Service Area III well is likely producing from the Purisima Formation F unit at 10 to -250 feet msl. However, the well is evaluated as part of the Aromas area because SqCWD 's other Service Area III wells are screened in both the Aromas Red Sands and Purisima F unit. The hydrologic connection between the Purisima F unit and the Aromas Formation is shown in the continuous water level contours mapped between the Aptos Jr. High well and the CWD Rob Roy wells #4, #10, and #12 for April 2008 (Figure 24). Additional smooth contours showing the effects of dry season pumping at the Aptos Jr. High well and Rob Roy well field are shown on Figure 25. CWD's Cox wells #3 and #5 are also screened in the Purisima F unit. They are shown on

Figure 21 because, similar to the Aptos Jr. High well, they are considered to be in the Aromas area.

Figure 21: Aromas Area Wells

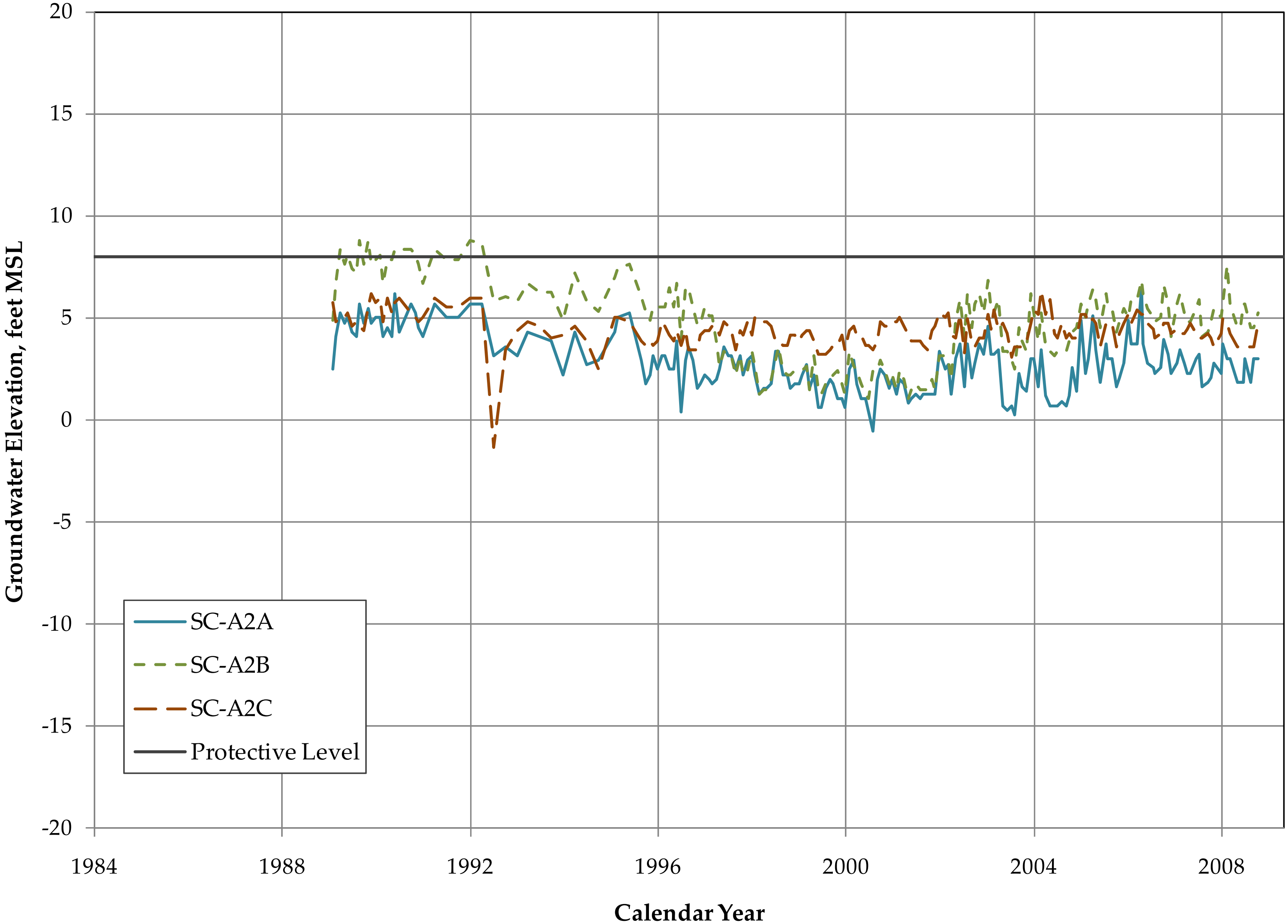

Figure 22: Monitoring Well Cluster SC-A2 Hydrographs

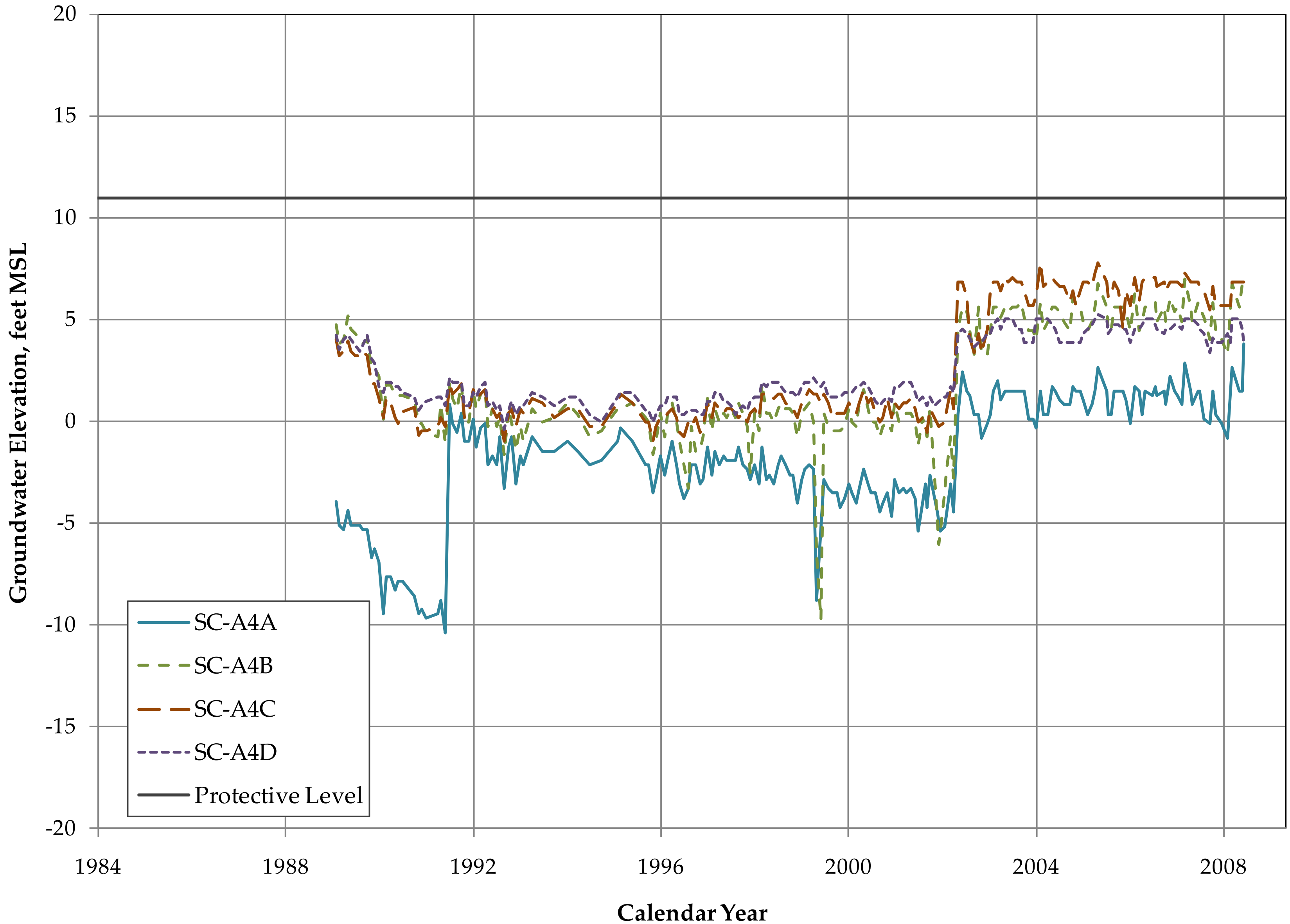

Figure 23: Monitoring Well Cluster SC-A4 Hydrographs

Figure 24: Aromas Area Groundwater Contours, April 2008

Figure 25: Aromas Area Groundwater Contours, October 2008

AROMAS AREA GROUNDWATER LEVEL CHANGE MAPS

Contour maps of the differences in groundwater elevations between Water Years 2008 and 2007 (one year), 2008 and 2003 (five years), and 2008 and 1998 (ten years) were created for the Aromas area for both April and October. These water level difference contours show how much groundwater levels have changed over the specific time period. The figures were created with the same technique used for the Purisima Formation figures. Hatched contour lines represent declining groundwater levels, while unhatched contour lines represent increased groundwater levels. The contour intervals in the Aromas area groundwater level change figures are smaller than the contour intervals used in the Purisima Formation water level change figures; a 2-foot contour interval is used in the Aromas figures rather than the 5-foot interval used in the Purisima Formation figures. This reflects the smaller groundwater level changes that are seen in the Aromas area, which in turn reflect a more subdued response to pumping. In accordance with the groundwater level contours developed for the *Water Year 2007 State of the Basin Report* (HydroMetrics LLC, 2009a), data used to create these maps come from both the lower Aromas unit and the Purisima F unit.

All the Aromas area contour maps (Figure 26 through Figure 31) are dominated by the groundwater level decline around the Aptos Junior High well. This obvious decrease occurred because the well was reactivated in March 2007, after being inactive since 1986. This does not indicate a long-term trend as it is more a function of the well returning to operation. There will be additional water level declines in the future if production at this well is increased. However, if production remains consistent over time, water levels should stabilize unless the production amount is not in balance with recharge.

Other trends occurring include a stable trend in the very south of the area near monitoring well SC-A4. In general, the area south of the Country Club well has had stable water levels over the past year, with an increasing long-term (five- to ten-year) trend. The increasing levels over the long-term are probably a result of the reduction in pumping in SqCWD's Aromas area wells. The area around the Altivo, Bonita and CWD #4 and CWD #10 wells are the only areas that experienced a decline over the past year (Figure 29) instead of stable levels.

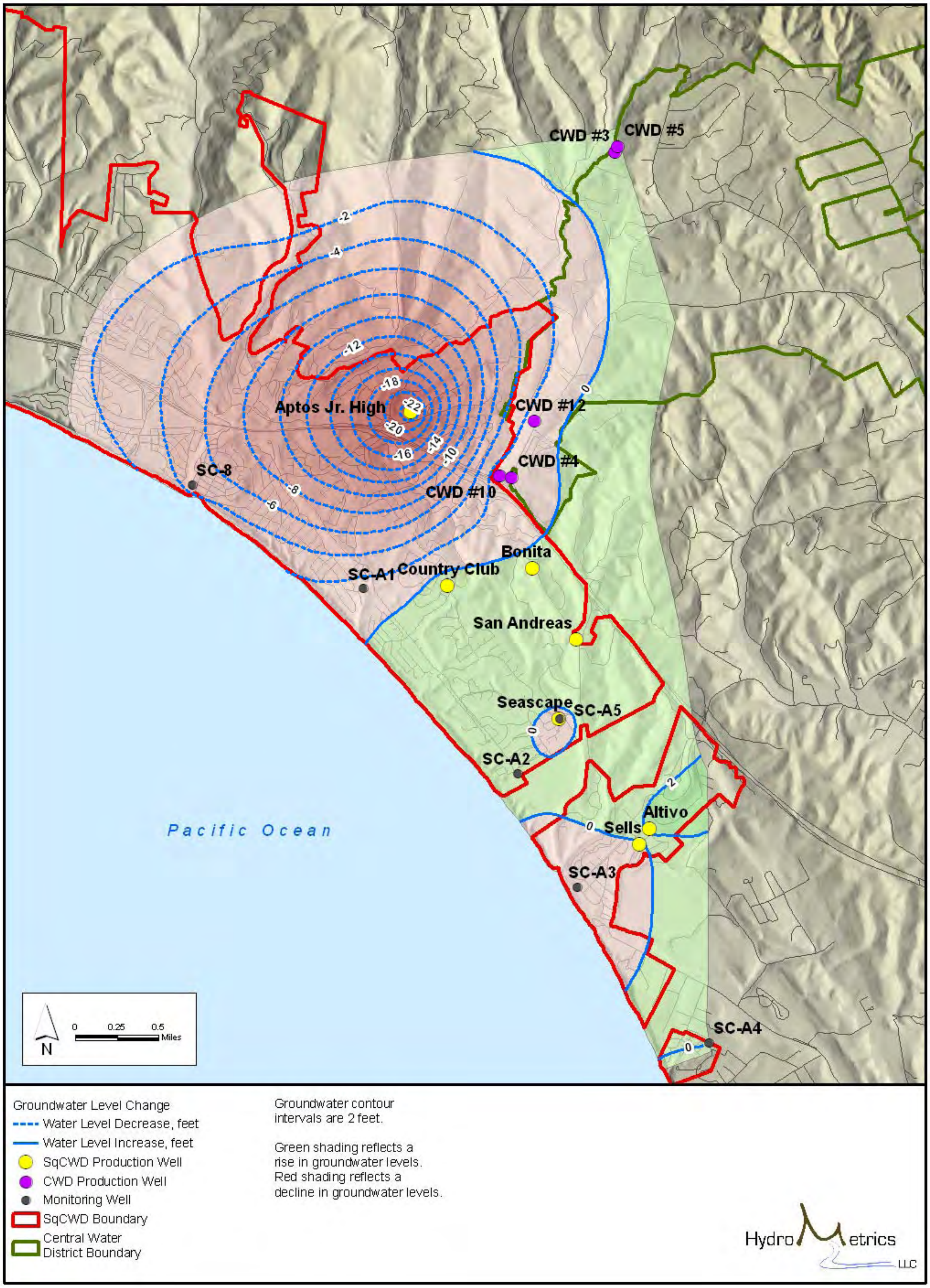

Figure 26: One Year Water Level Changes, Aromas Area, April 2008 – April 2007

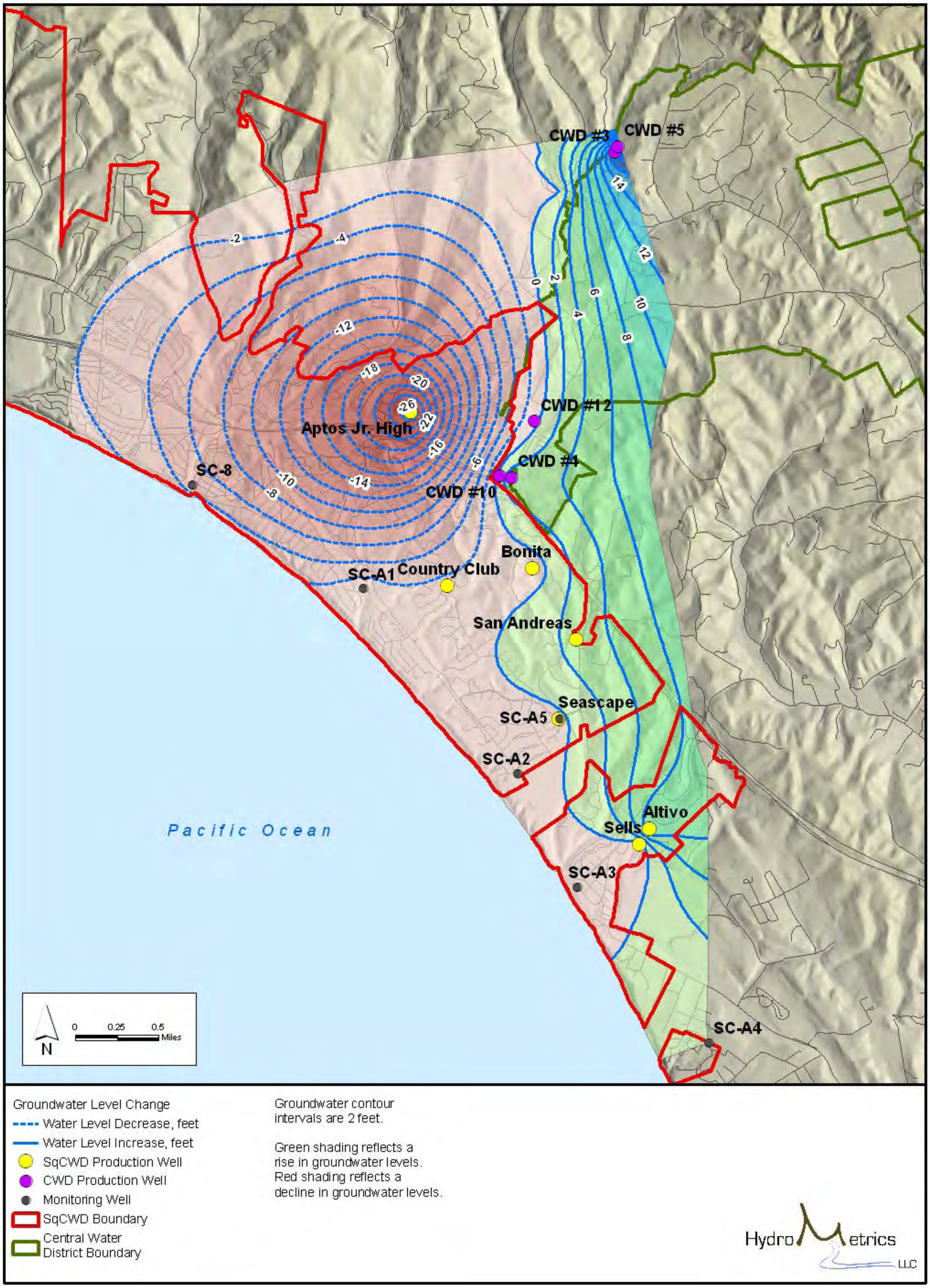

Figure 27: Five Year Water Level Changes, Aromas Area, April 2008 – April 2003

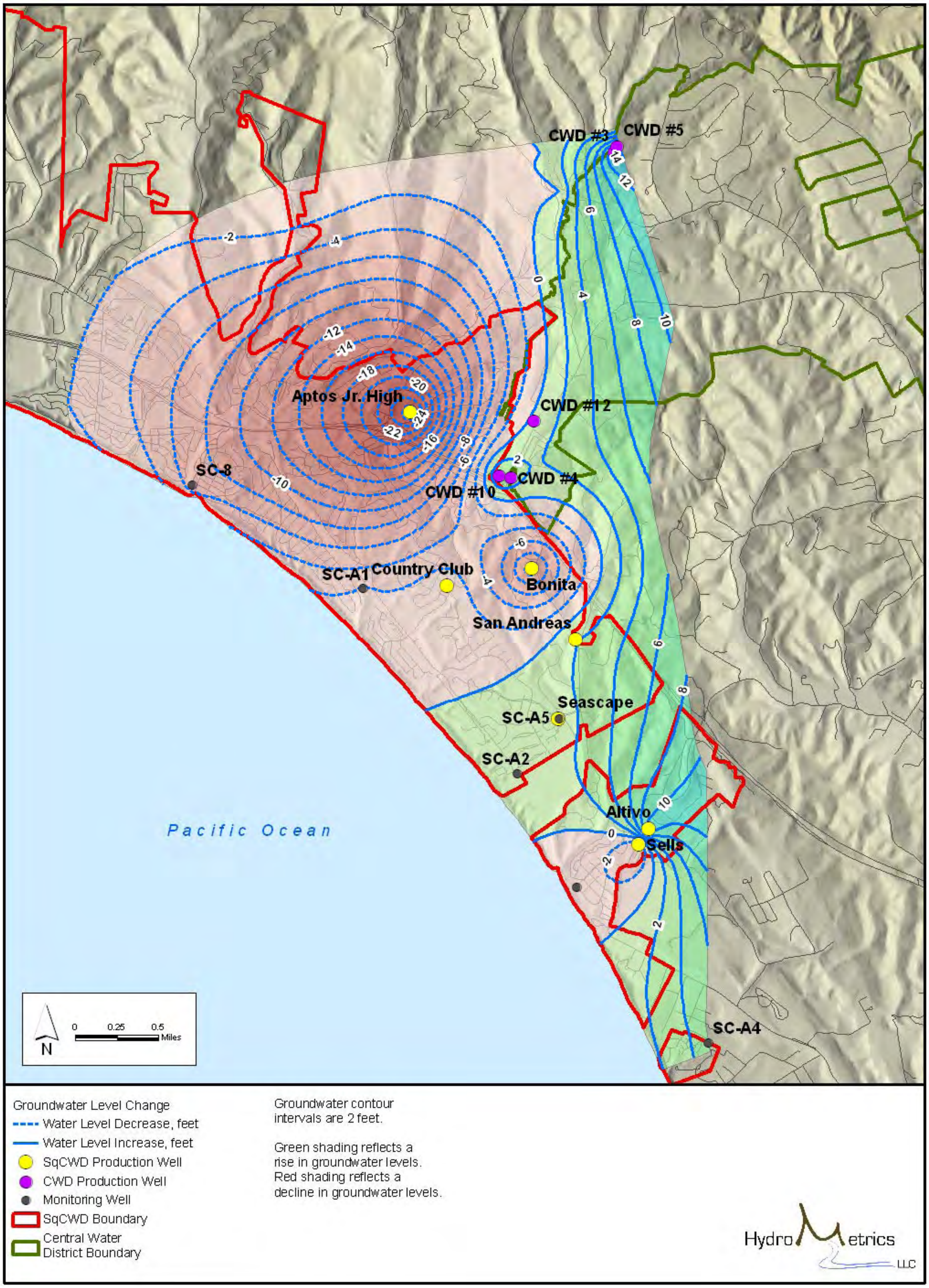

Figure 28: Ten Year Water Level Changes, Aromas Area, April 2008 – April 1998

Figure 29: One Year Water Level Changes, Aromas Area, October 2008 – October 2007

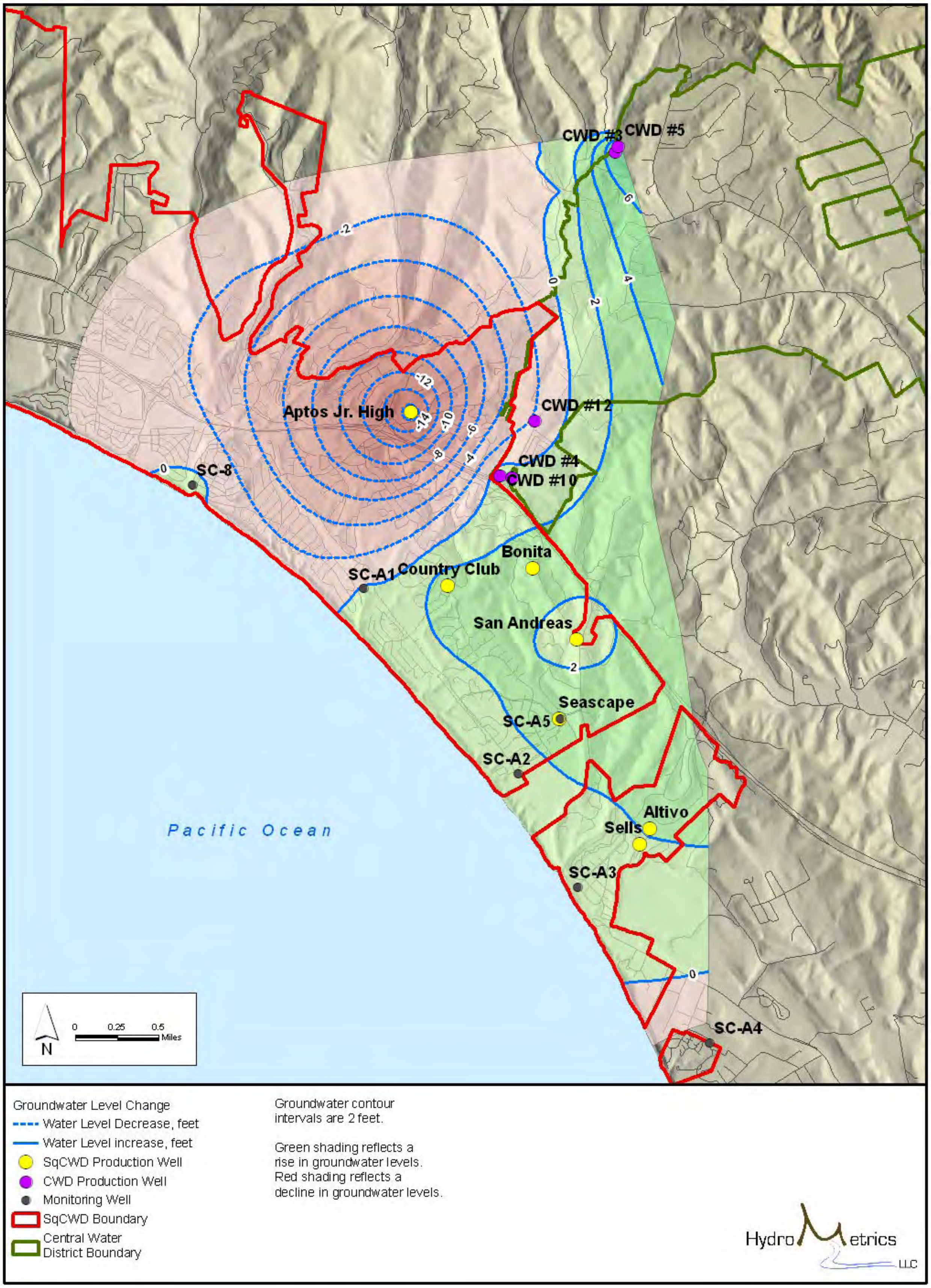

Figure 30: Five Year Water Level Changes, Aromas Area, October 2008 – October 2003

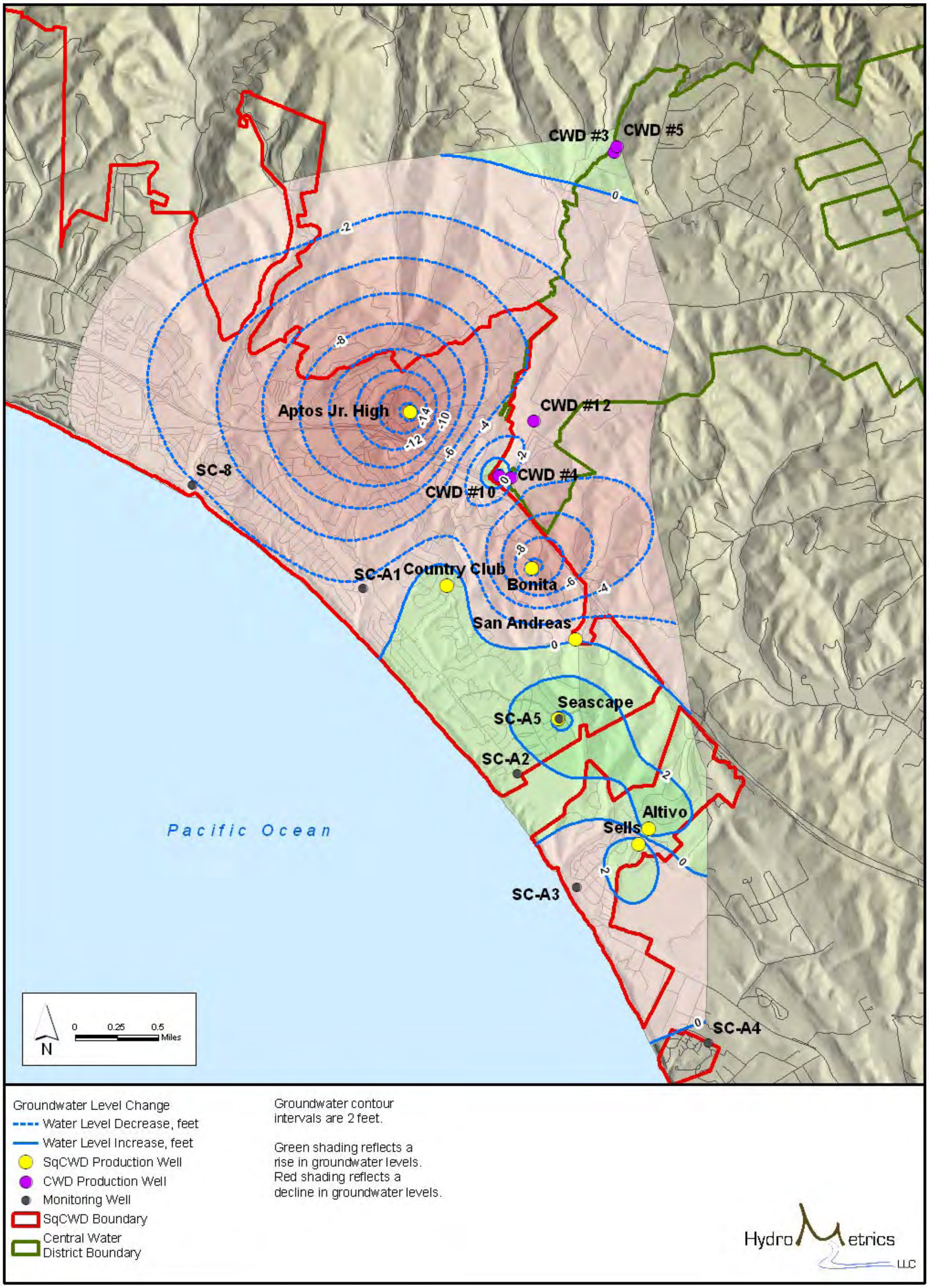

Figure 31: Ten Year Water Level Changes, Aromas Area, October 2008 – October 1998

2.3 Groundwater Quality and Seawater Intrusion

The most significant water quality threat to SqCWD and CWD production is seawater intrusion. Coastal groundwater elevations in the Soquel-Aptos area have been near or below sea level since groundwater monitoring was initiated in 1983. These low groundwater elevations may provide the opportunity for seawater intrusion into both the Purisima Formation and the Aromas Red Sands.

Increasing Total Dissolved Solids (TDS) and chloride are indicators of potential seawater intrusion. Chloride and TDS measurements are collected regularly by SqCWD from both production wells and observation wells. The observed TDS and chloride levels do not suggest any seawater intrusion currently impacting the production wells in either the Purisima Formation or Aromas Red Sands. However, seawater intrusion has been evident in the past at some Purisima monitoring wells, and monitoring wells in the Aromas Red Sands currently show ongoing seawater intrusion. A complete set of TDS and chloride data for SqCWD production wells and monitoring wells in both the Purisima Formation and Aromas Red Sands, updated through Water Year 2008, is included on the accompanying CD.

2.3.1 Purisima Formation Water Quality

Representative chemographs from the Purisima Formation monitoring wells are shown here to illustrate various aspects of Purisima Formation water quality. Figure 32 presents measured TDS concentrations, chloride concentrations, water levels, and nearby pumping rates for monitoring well SC-1A. This well is between the ocean and the Garnet well. According to Johnson et al. (2004), this area of the Purisima A-unit is prone to seawater intrusion because the aquifer is close to, or exposed on, the seafloor.

Chloride concentrations in monitoring well SC-1A dropped starting in 1996, correlating with the period when production switched from the Opal#1 well to the new Garnet well. The switch from the Opal well to the Garnet well shifted pumping to a deeper interval; the Opal#1 well was screened from -28 to -130 feet msl and the Garnet well is screened from -83 to -209 feet msl. Therefore, the top of the pumped zone was shifted down 55 feet. Pumping in a deeper part of the aquifer may have allowed groundwater levels in the shallower zones of the Purisima A-unit to recover, despite increased pumping. Groundwater levels recovered to levels high enough to prevent, or at least reduce, intrusion in this zone. A spike in chloride and TDS was observed in this well in 2005 following an increase in pumping at the Garnet well in 2004. The drop from the 2005 spike in chloride and TDS appears to be the result of the SqCWD reducing pumping at the Garnet well. Pumping reductions in water years 2005 and 2006 at the Live Oak well field may also have contributed to this decline in concentrations, although no clear relationship between Live Oak well field pumping and water quality at the SC-1 wells has been established. There have been no water sampling events at this well from July 2007 to September 2008 because a groundwater level transducer was installed in this well instead of sampling equipment (HydroMetrics LLC, 2007).

The data are inconclusive on whether the 2005 spike in chloride and TDS at SC-1A is a result of seawater being pulled from the Pleasure Point area, or from directly offshore. The City of Santa Cruz's coastal monitoring wells such as Pleasure Point and Soquel Point are along the strike of the A unit, between the seabed exposure of the A unit and monitoring well SC-1A. If the chloride spike was derived from the Pleasure Point area, we would expect to observe an earlier spike in chlorides and TDS at the City's monitoring wells. This was observed in the early to mid 1990s when rising chlorides at the Beltz #2 well preceded the spike in chloride and TDS at monitoring well SC-1A in 1996. However, chloride data in the City’s wells are insufficient to assess whether a similar increase occurred prior to 2005. Therefore it cannot be determined whether the chloride spike in 2005 was derived from the Pleasure Point area or from directly offshore of the Garnet well. Because the groundwater levels in the SC-1A well are closely correlated with pumping from the Garnet well, and groundwater levels in the City’s Pleasure Point monitoring wells are poorly correlated with pumping from the Garnet well, the simplest explanation is that the increase in chlorides was derived from directly offshore of the SC-1A monitoring well.

Chemographs showing chloride and TDS data, along with a hydrograph for monitoring well SC-8F is included on Figure 33. Chloride levels in monitoring well SC-8F have historically shown TDS and chloride spikes that were assumed to result from seasonal seawater intrusion. This well is completed in the shallowest sediments adjacent to Aptos Creek, and may be completed in the Creek’s alluvium rather than the Purisima Formation. This well is currently in poor condition, with sand filling the well up to 100 feet below ground surface.

A review of historical water quality data shows that there may be erroneous laboratory data from well SC-8F. It appears that TDS and Chloride concentrations in samples collected between January 1999 and 2003, and analyzed at Soil Control Laboratory, were an order of magnitude higher than samples analyzed in the field on the same day or within the same month. These laboratory results produce the spikes on the chloride and TDS charts on Figure 33. It is unknown if laboratory error produced the chloride spikes of approximately 5,000 milligrams per Liter (mg/L) observed in 1984, 1988 and 1990. Laboratory and field measurements of TDS and chloride concentrations match well after 2002.

Figure 33 shows a sudden chloride concentration increase in February 2007, from 20 to 2,770 mg/L. Since that date, chloride concentrations have continued to increase to 3,100 mg/L. The TDS concentration mimicked the chloride concentrations somewhat, except for a spike in April 2008 which doubled the concentration from 7,500 to 15,000 mg/L. This may have been an anomalous result as the next sample was back down at 15,000 mg/L in July 2008. Due to the sanding in the well, it is uncertain what is actually being sampled by the well and it is recommended that the well be replaced as soon as possible.

Figure 34 presents TDS concentrations, chloride concentrations, and water level elevations at monitoring well SC-9E. Chloride concentrations in this monitoring well have shown seawater intrusion in the past. Monitoring well SC-9E had high chloride levels prior to the retirement of the Hillcrest well approximately 1,000 feet inland. In 1987 the chloride concentration at well SC-9E peaked at over 400 mg/L. After the Hillcrest well was abandoned, water levels recovered and the chloride levels dropped to background levels. Chloride concentrations in monitoring well SC-9E are similar to Water Year 2007 concentrations, which are below 40 mg/L.

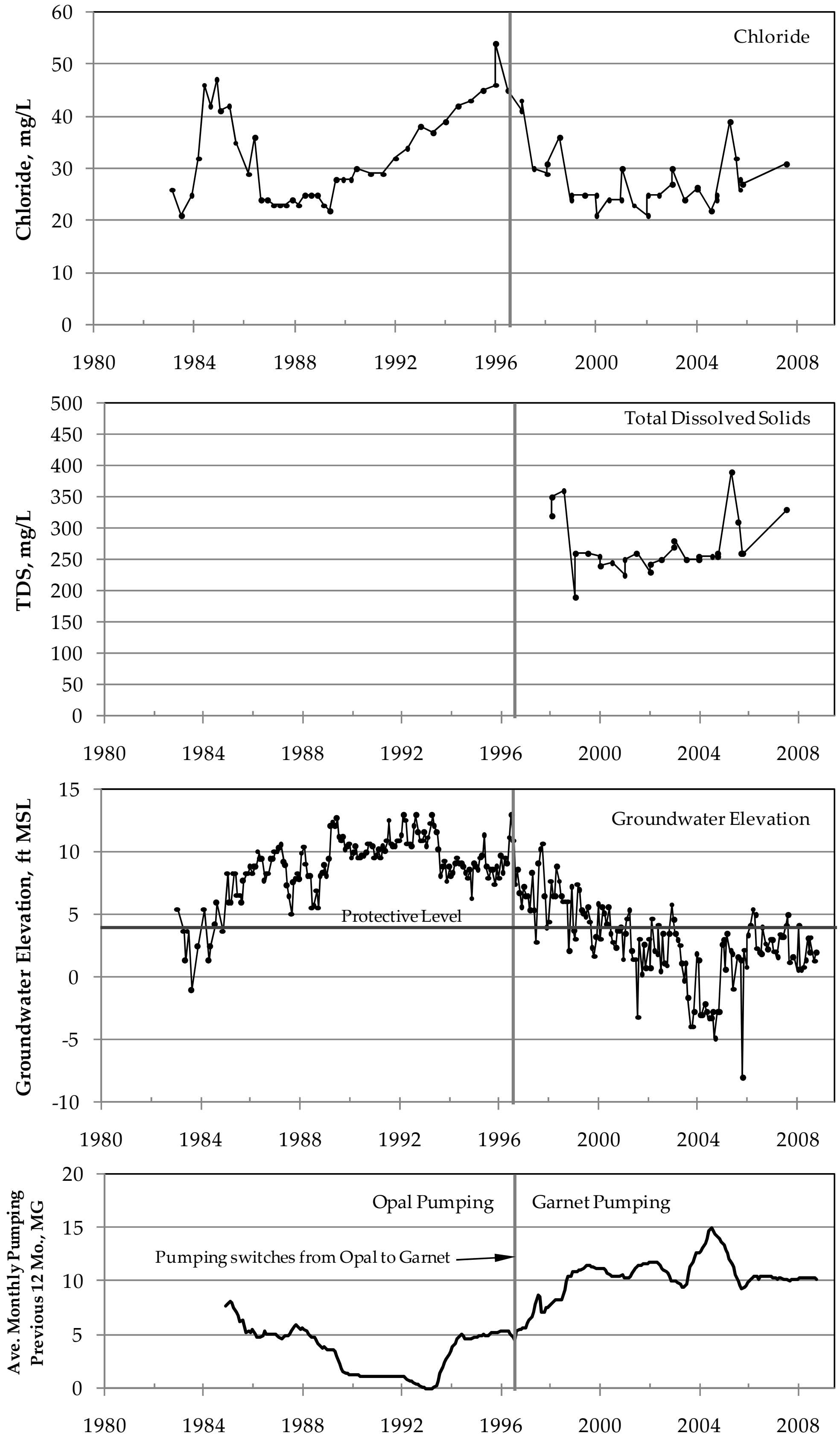

Figure 32: SC-1A Chemographs and Hydrograph

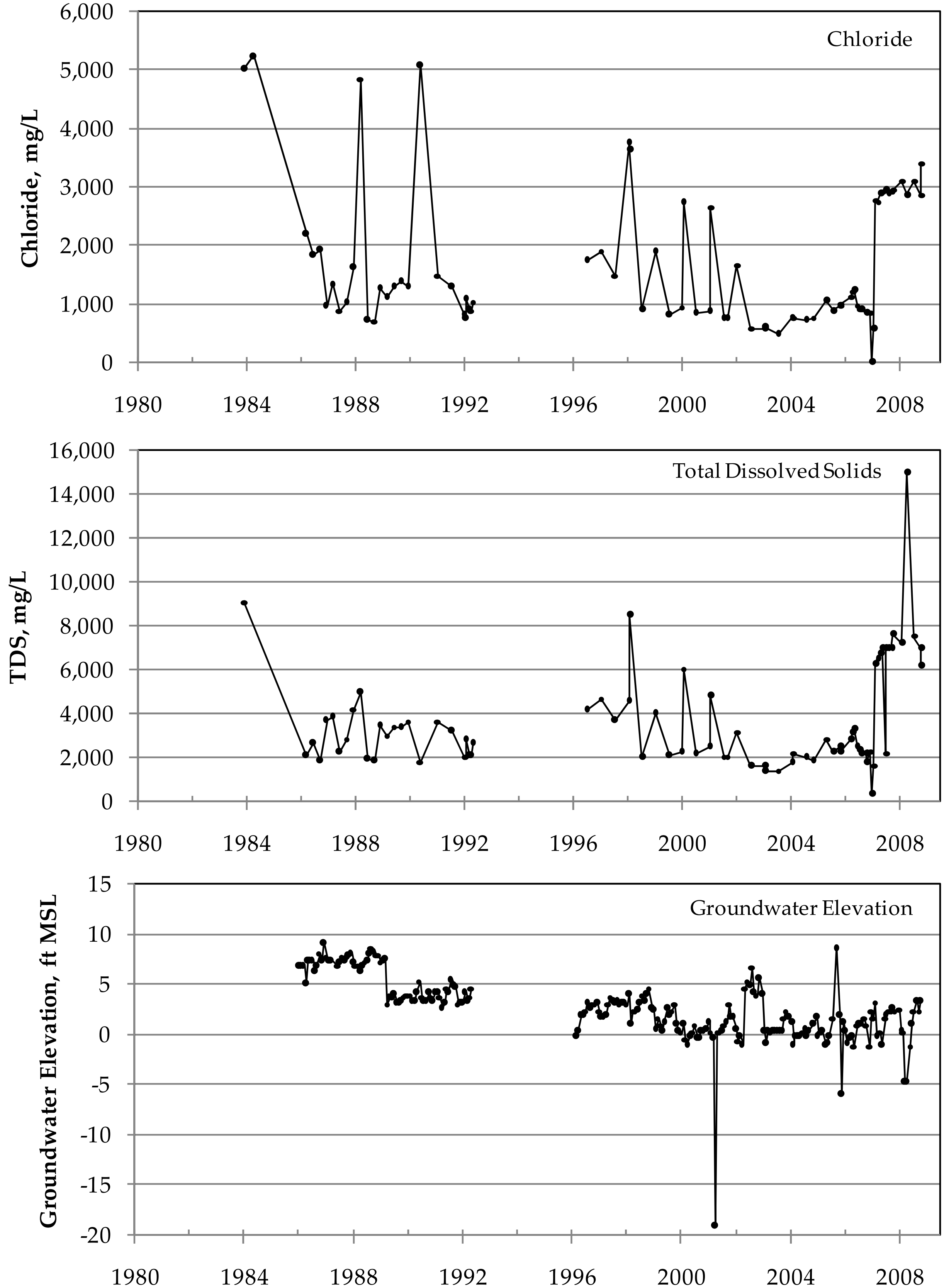

Figure 33: SC-8F Chemographs and Hydrograph

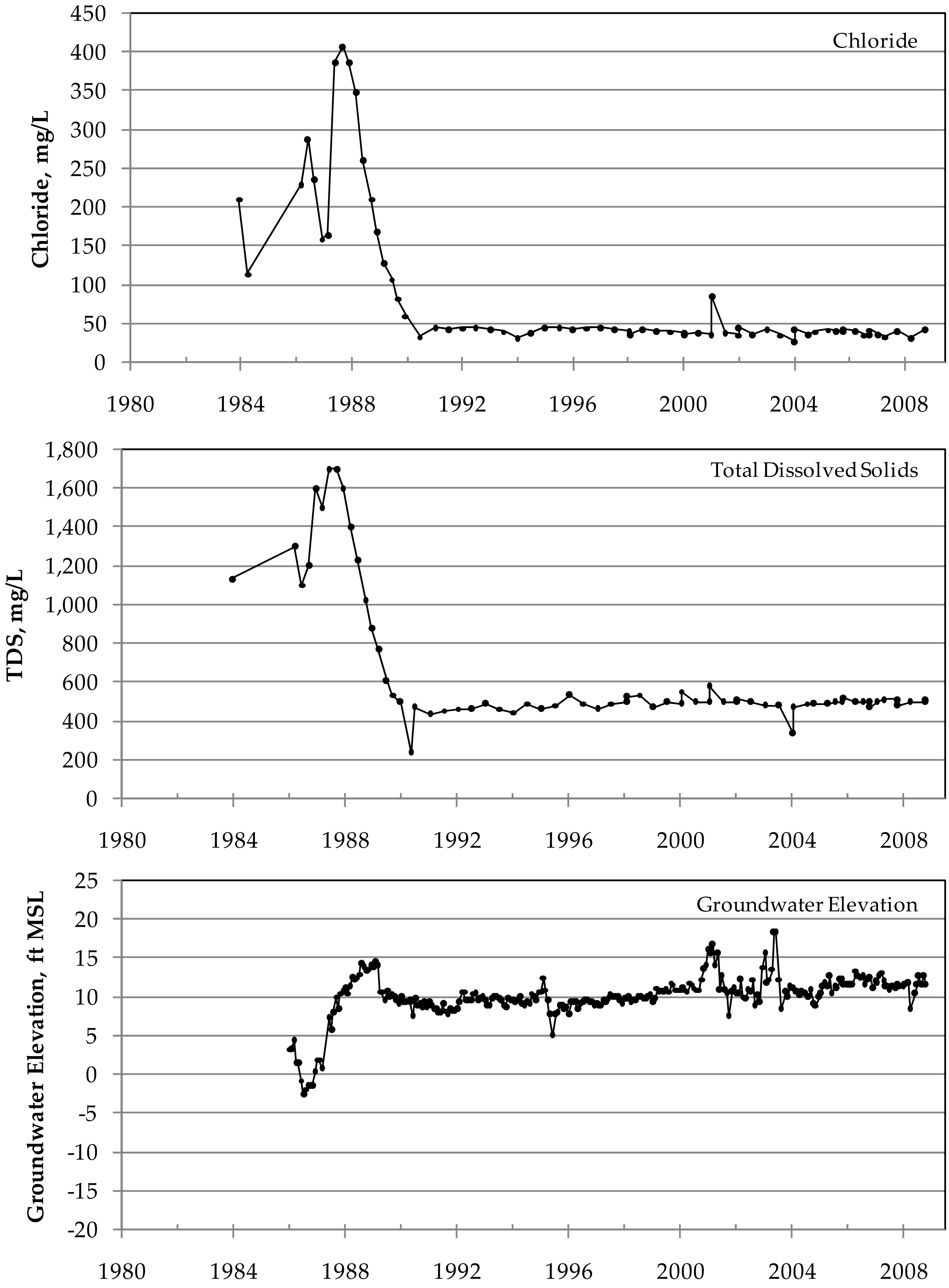

Figure 34: SC-9E Chemographs and Hydrograph

2.3.2 AROMAS AREA WATER QUALITY

With the exception of monitoring well cluster SC-A1, monitoring wells in the Aromas area were installed such that the two deepest completions bounded the freshwater/seawater interface at the time of installation. As seawater intrusion has progressed in the Aromas Formation, the shallower B-completion monitoring wells have become intruded at the SC-A2 and SC-A3 monitoring well clusters. Figure 35 and Figure 36 show measured TDS concentrations, chloride concentrations, and groundwater levels in monitoring wells SC-A2B and SC-A3B, respectively. Concentrations of both TDS and chloride in well SC-A2B have historically shown a steady increase, indicating ongoing seawater intrusion. Concentrations of both TDS and chloride in well SC-A3B rose rapidly in the mid-1990s, dropped slightly until 2004, then rose again. Concentrations in well SC-A2B have risen monotonically since the early 1990's. Concentrations are much higher in well SC-A3B than well SC-A2B.

During Water Year 2008, concentrations of chloride and TDS continued to rise in well SC-A2B. Chloride and TDS concentrations have been increasing since May 2007 in well SC-A3B. The TDS concentration in well SC-A3B experienced an historically high level in September 2008, in spite of a very small change in water level elevation in well SC-A3B during Water Year 2008. Groundwater levels in the Aromas area monitoring wells have been consistently below protective levels.

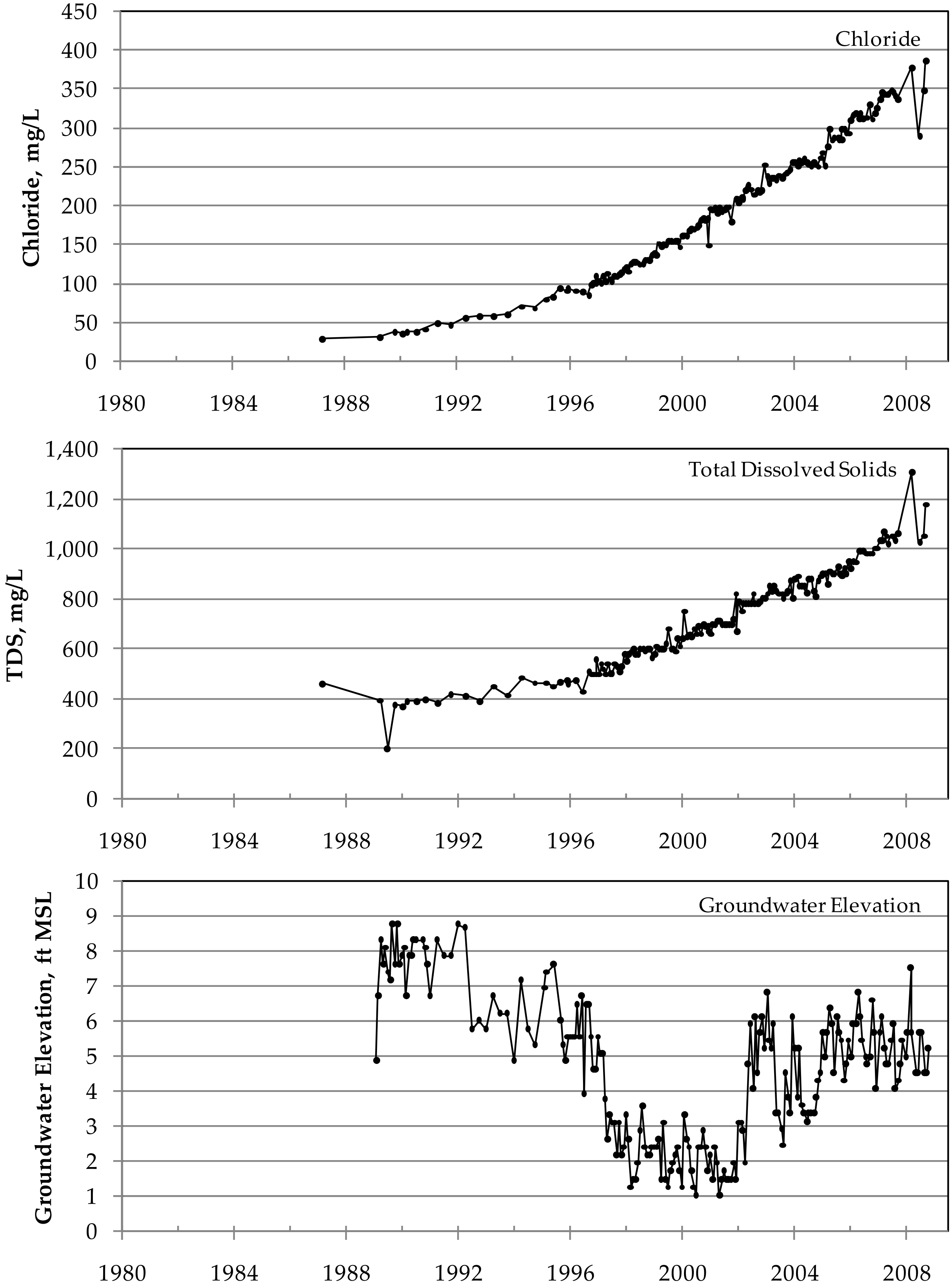

Figure 35: SC-A2B Chemographs and Hydrograph

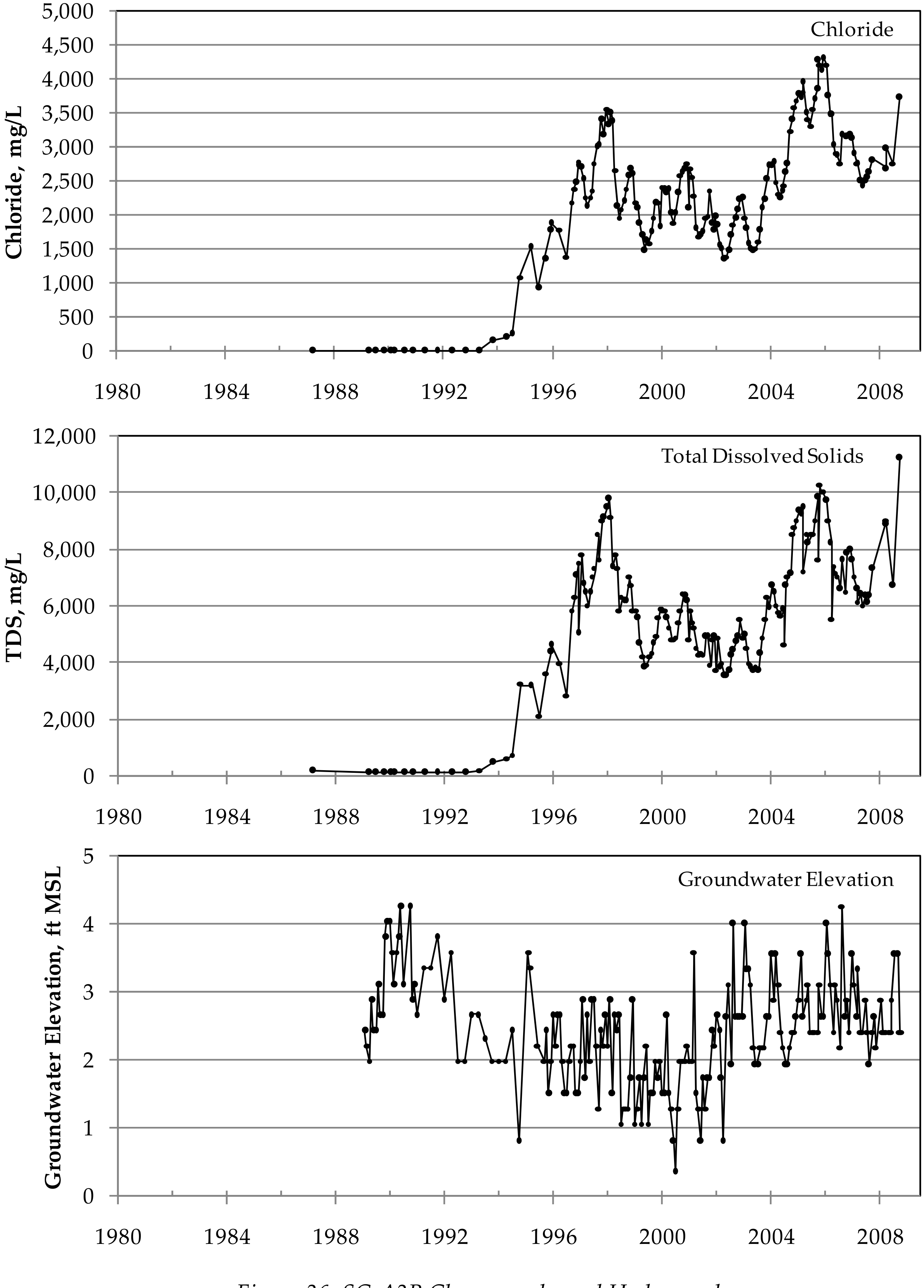

Figure 36: SC-A3B Chemographs and Hydrograph

2.4 GROUNDWATER PUMPING

2.4.1 TEMPORAL CHANGES IN PUMPING

Water Year 2008 total groundwater pumping by SqCWD was 1,562 million gallons (4,795 acre-feet). Of this, 958 million gallons (2,941 acre-feet) were pumped from the Purisima Formation and 604 million gallons (1,854 acre-feet) were pumped from the Aromas area. The SqCWD Water Year 2008 total pumping represents a decrease of 1.9 percent from Water Year 2007 and a reduction of 7.2 percent from the average production of the previous five years.

The total amount of groundwater pumped by SqCWD in Water Year 2008 was the second lowest since Water Year 1986. This is the fourth year in a row that SqCWD has maintained significantly lower pumping than observed in the previous 18 years.

Figure 37 shows total annual SqCWD pumping, and pumping for each formation individually. Total SqCWD pumping has remained steady for over 20 years, with no clear trend of increasing or decreasing pumping. SqCWD pumping in the Aromas and Purisima areas has also remained steady since 1986 with no long term trends.

Johnson et al. (2004) estimated that SqCWD pumping represents approximately half of the total pumping in the Soquel-Aptos area. Other production wells are owned and operated by Central Water District, the City of Santa Cruz, small or private water systems, and residential and agricultural water users. Extraction data is currently only available from the other two public water purveyors: CWD and the City of Santa Cruz. The City of Santa Cruz (City) operates its Live Oak well field on a seasonal basis and the amount of pumping fluctuates considerably based on the availability of surface water supplies. For Water Year 2008, the City's total pumping was 168 million gallons (518 acre-feet). This is 36 acre-feet more than what was pumped during Water Year 2007 pumping, and an increase of 48 acre-feet above the average of the previous five years. The City's Water Year 2008 pumping is the second consecutive annual pumping increase in City extractions and reflects the City's surface water availability.

Water Year 2008 pumping by CWD was 190 million gallons (583 acre-feet). This is 12 acre-feet less than what was pumped during Water Year 2007, and an increase of 10 acre-feet above the average of the previous five years.

shows pumping by Water Year by the City of Santa Cruz and CWD for the Purisima and Aromas formations. . These graphs show that pumping by CWD from the Purisima Formation is small compared to that of SqCWD and the City. Unlike SqCWD pumping shown in Figure 37, long-term trends are seen in the pumping of the City and CWD. Figure 38shows that both the City and CWD have in general decreased pumping from the Purisima Formation over the last twenty years. Pumping from the Purisima Formation was reduced by CWD as it shifted most of its pumping to the Aromas Red Sands due to the high levels of iron and manganese in the Purisima Formation. Pumping by the City appears to have leveled off since 1999, with some fluctuation reflecting demands related to surface water availability.

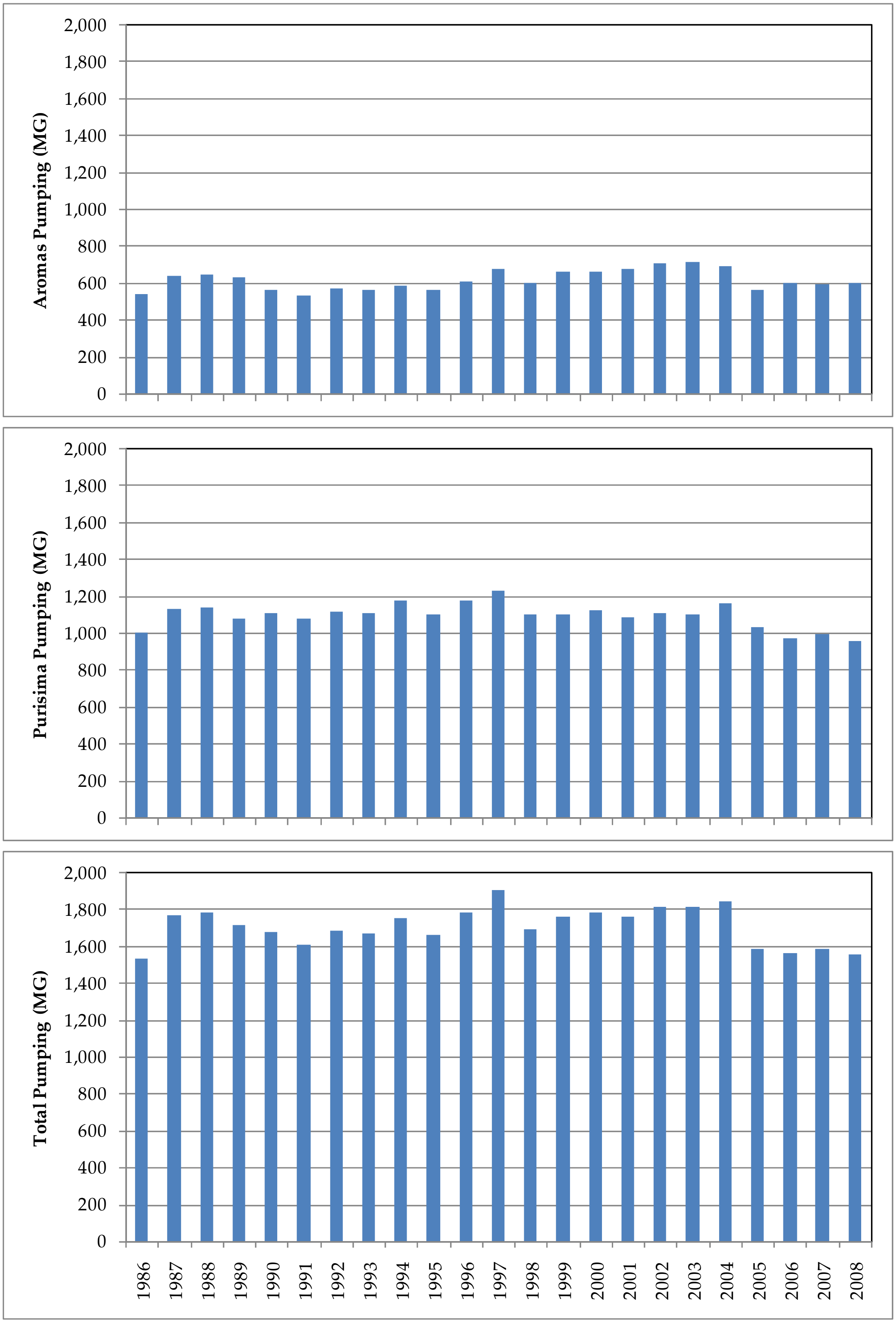

Figure 37: SqCWD Pumping by Water Year

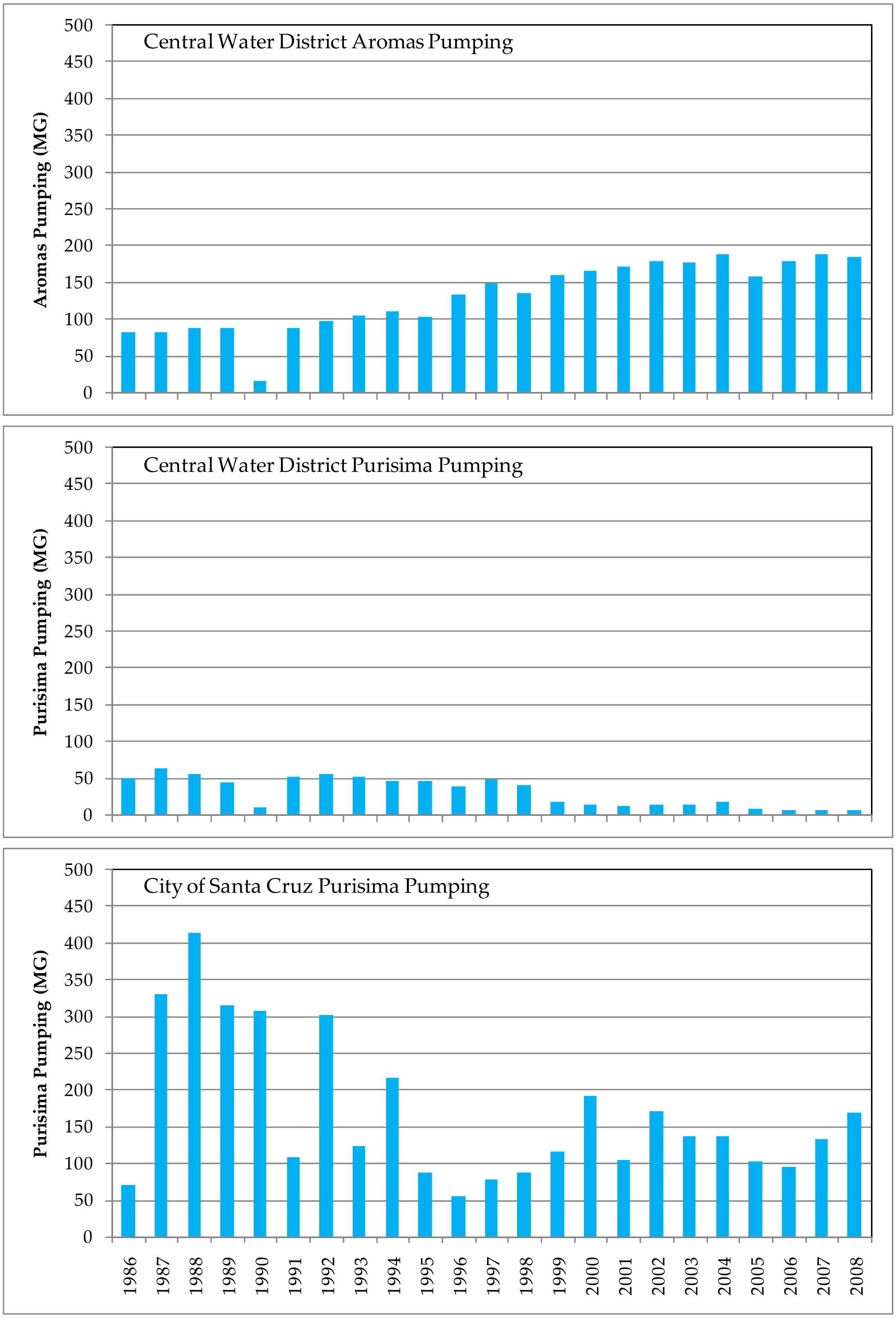

Figure 38: City of Santa Cruz and Central Water District Pumping

2.4.2 Comparison with Sustainable Yield Estimates

Johnson et al. (2004) constructed a water budget for the Soquel-Aptos Basin and estimated that the sustainable yield for the basin had been exceeded by at least 700 acre-feet/year on average. Pumping in the Purisima Formation accounts for approximately 400 acre-feet of this annual overdraft, and pumping from the Aromas Red Sands accounts for the remaining 300 acre-feet of annual overdraft. To stop this overdraft and protect against seawater intrusion, Johnson assumed that the total sustainable yield for all pumpers in the Soquel-Aptos area is no more than 6,200 acre-feet/year in the Purisima Formation, and no more than 3,200 acre-feet/year in the Aromas Red Sands (Johnson et al., 2004, pg 8-8). Within the context of an overall regional solution to address overdraft, SqCWD set a goal in the Groundwater Management Plan of limiting its total annual groundwater yield to no more than 4,800 acre-feet/year, apportioned as 3,000 acre-feet/year (977 million gallons) from the Purisima Formation and 1,800 acre-feet/year (586 million gallons) from the Aromas Red Sands (SqCWD and CWD, 2007).

Figure 39 compares actual pumping to the pumping goals set by SqCWD. The pumping goals are shown as horizontal lines across each chart. Pumping is represented by vertical bars. Pumping is illustrated for three cases: average from Water Years 2003 through 2007, Water Year 2007, and Water Year 2008. The average pumping for Water Years 2003 through 2007 was higher than the District's target levels in both the Aromas Red Sands and the Purisima Formation. During Water Year 2007 there was a negligible difference between the pumping goals and the amount of water actually pumped in both the Aromas Red Sands and Purisima Formation. During Water Year 2008, pumping from the Aromas Red Sands was slightly higher than Water Year 2007; and was slightly above the SqCWD's target pumping volume of 586 million gallons. In the Purisima Formation, pumping decreased to 958 million gallons during Water Year 2008, which was below the target volume of 977 million gallons. The ability of SqCWD to maintain pumping near the target goals can be credited to conservation efforts, considering the anticipated high water demand due to the limited rainfall during Water Years 2007 and 2008.

Meeting the Groundwater Management Plan's sustainable yield goal alone is not enough for SqCWD to prevent seawater intrusion in the Soquel-Aptos Basin. The sustainable yield estimate is based on a mass balance that lumps groundwater inflow and outflow from all of the aquifers together. This mass balance approach gives an estimate of total groundwater outflow or inflow, but does not specify the amount of groundwater outflow or inflow from or into the individual aquifers needed to prevent seawater intrusion. It is possible that while the overall sustainable yield estimates are being met, intrusion or excessive outflow may be occurring in individual aquifer units. Pumping must still be distributed correctly within the aquifer system in order to avoid excessively low coastal water levels and seawater intrusion. In addition, historic overdraft has lowered coastal water elevations below protective levels. Meeting sustainable yield goals with an appropriate distribution may prevent further decreases in groundwater levels, but may not recover the basin to protective levels. Pumping below the sustainable yield amounts will be required over multiple years to recover the basin.

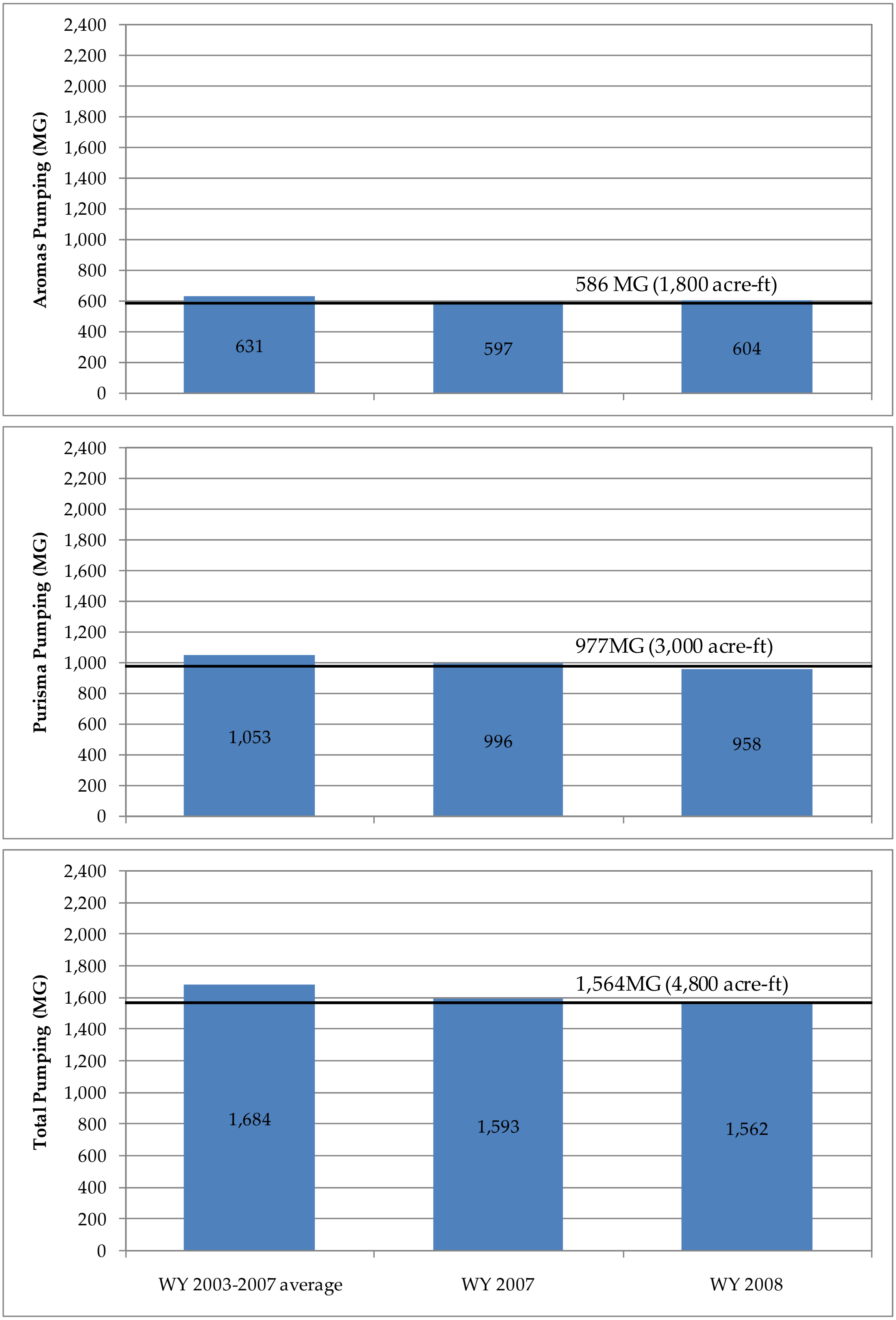

Figure 39: Comparison of SqCWD Pumping with Sustainable Yield Estimate

2.4.3 ESTIMATES OF PUMPING BY NON-WATER AGENCY PUMPERS

Complete estimates of pumping by non-water agency pumpers have not been updated since Johnson et al. (2004) documented estimates based on a previous SqCWD study (Faler, 1992) and a Santa Cruz County Environmental Health Services report (Wolcott, 1999). The Wolcott study completed water use estimates for the Purisima area as summarized in Table 1.

Table 1: Previous Estimates of Non-Water Agency Pumping in the Purisima Area.

User		Estimated Water Use (af/yr)	Source	Comments
Private Urban	Residential and Commercial	124	Wolcott, 1999	may include stream diversions.
	Agriculture	93		
	Seascape Golf Course	232		
Private Rural	Residential and Commercial	1,099	Wolcott, 1999	
	Agriculture	163		
Small Water Systems	Cabrillo College indoor	200	Wolcott, 1999	
	Cabrillo College outdoor	85		
	Other Urban	29		
	Rural	211		
Total Purisima Area		**2,236**		

The Wolcott study did not complete water use estimates for the Aromas area, but did provide more up-to-date water use factors than the Faler study. Therefore, Johnson et al. (2004) applied water use factors in the Wolcott study to the parcel and small water system information provided in the Faler study to estimate water use estimates for the Aromas area. The estimates exclude parcels and water systems south of Manresa Beach (Johnson et al., 2004). These estimates are summarized in Table 2. Table 2 also shows a more recent estimate for irrigation pumping at the Polo Grounds well provided by the Santa Cruz County Parks Department (Branham, 2007).

Table 2: Previous Estimates of Non-Water Agency Pumping in the Aromas Area.

	User	**Estimated Water Use (af/yr)**	**Source**	**Comments**
	Polo Grounds Park	30	Branham, 2007	
Private Rural	Residential and Commercial	557	Faler, 1992, and Wolcott, 1999	Parcel count and areas from Faler
	Agriculture	309		
Small Water Systems	Rural	58	Faler, 1992, and Wolcott, 1999	Number of connections from Faler
Total Aromas Area		**954**		

2.5 IDENTIFICATION OF DATA GAPS

This section identifies current data gaps that can be addressed in recently implemented or future programs. The list of these data gaps are as follows:

- Non-agency pumping. As shown in section 2.4.3estimates of non-agency pumpers are based on data from 1999 or earlier.
- Recharge estimates. Deep recharge estimates need to be refined to further evaluate the estimate of sustainable yield.
- Shallow water levels. Basin-wide shallow water level monitoring would help assess changes in basin storage. The County's recently implemented private well monitoring program may provide data to assess this data gap. The depths of the wells in this program would be compared to published elevations of aquifer unit depths. Multi-year data from wells completed in the shallowest unit could help quantify changes in basin storage.
- Continuous water level measurements in monitoring wells. The effects of tides, season, and pumping cycles could be evaluated by installing water level transducers in monitoring wells.

- Pumping requirements for recovery. It is unknown how much pumping will need to be reduced for how long to recover the basin. Reducing pumping to gather data for this question may require a supplemental supply.
- Monitoring wells between pumping areas. The monitoring network includes coastal wells, wells adjacent to pumping wells, and wells upland of pumping areas. There are no monitoring wells placed to monitor potential well interference between pumping areas or to assess inland advancement of seawater intrusion in the Aromas area.

Section 3
GROUNDWATER MANAGEMENT PLAN IMPLEMENTATION STATUS

3.1 STATUS OF BASIN MANAGEMENT OBJECTIVES

The 2007 Groundwater Management Plan (SqCWD and CWD, 2007) listed nine Basin Management Objectives (BMOs). The status of each of the BMOs during Water Year 2007 is summarized below. Each BMO in the Groundwater Management Plan (GMP) is listed, along with an assessment of how well the objective was met in Water Year 2008. Specific basin management activities, or elements, are discussed in Section 3.2.

BMO 1-1: PUMP WITHIN THE SUSTAINABLE YIELD

- SqCWD's groundwater pumping for Water Year 2008 was 4,795 acre-feet, slightly under SqCWD's self-imposed target of 4,800 acre-feet per year. SqCWD pumped 2,940 acre-feet from Service Areas I and II, less than SqCWD's target of 3,000 acre-feet for the Purisima area. SqCWD pumped 1,855 acre-feet from Service Areas III and IV, slightly more than SqCWD's target of 1,800 acre-feet for the Aromas area.

- SqCWD has been within 2% of meeting its overall pumping target for four consecutive Water Years.

- CWD's groundwater pumping for Water Year 2008 was 18 acre-feet in the Purisima Formation and 565 acre-feet in the Aromas Red Sands, which meets CWD's target objectives for pumping within the sustainable yield.

- CWD has been within its pumping targets consistently over the last 20 years.

- SqCWD and CWD's target pumping are within the context of a total sustainable yield estimate of 6,200 acre-feet per year for the Purisima area and 3,200 acre-feet per year for the Aromas area. Other pumpers in the Soquel-Aptos Area include the City of Santa Cruz and private domestic and agricultural wells.

- The City of Santa Cruz pumped 518 acre-feet from the Purisima area in Water Year 2008. This amount is the highest since 2002, but is still under the 575 acre-feet per year estimate (Johnson et al., 2004) that was used to establish SqCWD's target of 4,800 acre-feet per year in the Purisima area. It is also under the City's planned pumping of 645 acre-feet per year during normal years according to its *Integrated Water Plan* (Gary Fiske and Associates, 2003).

- The City of Santa Cruz has been at or under the estimate of 575 acre-feet per year since 1994.

- There have been no updates on pumping estimates for other pumpers in the basin, such as private wells and small water systems, since the GMP was enacted.

- Measured pumping amounts meet numerical targets set under this BMO; however, the basin remains in overdraft as water level recovery has not occurred . The sustainable yield estimate is in the process of being re-evaluated.

BMO 1-2: DEVELOP ALTERNATIVE WATER SUPPLIES TO ACHIEVE A LONG-TERM BALANCE BETWEEN RECHARGE AND WITHDRAWALS TO MEET CURRENT AND FUTURE DEMAND

- The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District ($SCWD^2$) desalination plant began testing in March 2008

- A tentative priority system for distributing water produced by the desalination plant was developed. The plan provides at least 1,148 acre-feet per year in all years to SqCWD for in-lieu recharge of the groundwater basin.

BMO 1-3: MANAGE GROUNDWATER STORAGE FOR FUTURE BENEFICIAL USES AND DROUGHT RESERVE

- Groundwater pumping in Water Year 2008 was not sufficiently below the sustainable yield to store water for future beneficial uses and drought reserve.

- The GMP states that "achieving this objective is likely to depend on first achieving BMO 1-1 and BMO 1-2 since storing surplus water will not be possible without first eliminating overdraft conditions and developing alternative supplies." BMO 1-1 may have been met in Water Year 2008, but BMO 1-2 is still several years from being achieved.

BMO 2-1: Meet existing water quality standards for beneficial uses, such as drinking water standards.

- Drinking water from SqCWD and CWD municipal wells was tested according to Title 22 requirements. In Water Year 2008, raw groundwater pumped by SqCWD from the Purisima Formation met all water quality standards except for iron and manganese. Raw groundwater that exceeded iron and manganese standards was treated to reduce these concentrations; all delivered water met drinking water standards. In Water Year 2008, groundwater from the Aromas Red Sands met all drinking water standards, thereby meeting the basin management objective for the Aromas Red Sands aquifer. Water pumped by CWD from its Purisima Formation and Aromas Red Sands sources met all drinking water standards.

- Groundwater from SqCWD monitoring wells was tested regularly for indications of seawater intrusion. No new intrusion was detected in monitoring wells that were previously un-impacted.

BMO 2-2: Maintain groundwater levels to prevent seawater intrusion

- Groundwater levels at coastal monitoring wells did not meet protective targets as outlined in *Groundwater Levels to Protect against Seawater Intrusion and Store Freshwater Offshore* (HydroMetrics LLC, 2008).

- Groundwater levels will not meet protective targets until BMO 1-2 is achieved together with pumping in the basin being maintained below the sustainable yield.

BMO 2-3 PREVENT AND MONITOR CONTAMINANT PATHWAYS

- SqCWD and CWD continue to implement Santa Cruz County's well abandonment ordinance.

- SqCWD has not updated its Drinking Water Source Assessment and Protection (DWSAP) report since the GMP has been enacted.

- Since the GMP has been enacted, CWD has updated its inventory of possible contaminating activities for the purposes of updating its DWSAP. The updated DWSAP will be completed in Water Year 2009.

BMO 3-1: MAINTAIN OR ENHANCE THE QUANTITY AND QUALITY OF GROUNDWATER RECHARGE BY PARTICIPATING IN LAND USE PLANNING PROCESSES

- In May 2008, County staff presented ongoing efforts for enhancing recharge to SqCWD Board of Directors. SqCWD budgeted $50,000 for fiscal year 2008-9 to supplement County efforts for recharge enhancement projects. These projects will be initiated by the County's technical advisory committee on recharge.

- CWD continued to maintain much of its area as a primary recharge area.

BMO 3-2: AVOID ALTERATION OF STREAMFLOWS THAT WOULD ADVERSELY IMPACT THE SURVIVAL OF POPULATIONS OF AQUATIC AND RIPARIAN ORGANISMS

- SqCWD continued to monitor streamflow and shallow groundwater levels near streams.

- Analyses of these data are not included in this report, but it is recommended that the data are analyzed regularly in a separate report, particularly as new production wells are installed.

- No minimum streamflows have been established for the survival of aquatic and riparian populations.

BMO 3-3: PROTECT THE STRUCTURE AND HYDRAULIC CHARACTERISTICS OF THE GROUNDWATER BASIN BY AVOIDING WITHDRAWALS THAT CAUSE SUBSIDENCE

- No subsidence was reported in Water Year 2008.
- SqCWD and CWD pumped within target amounts so withdrawals that cause subsidence are unlikely.

3.2 STATUS OF BASIN MANAGEMENT ELEMENTS

The Soquel-Aptos Basin Groundwater Management Plan Update includes 14 elements. Elements are the specific projects, programs, and policies that are planned for management of the Basin. Action items were identified for each element. This section provides a summary and status of the action items included in each element.

ELEMENT 1: GROUNDWATER MONITORING

1. ***Continue and expand existing regional groundwater monitoring programs***
   SqCWD and CWD continued measuring groundwater levels and sampling groundwater quality at its network of monitoring and production wells as described in the GMP.

   SqCWD expanded its network by adding monitoring wells at two locations. In Water Year 2008, quarterly water level measurements were initiated at the new Austrian Way well. In Water Year 2008, monthly water level measurements and quarterly water quality measurements were initiated at the three SC-A8 wells located at Dolphin Drive and Sumner Avenue.

   SqCWD has received Proposition 50 bond funding for installation of a monitoring well cluster at the Polo Grounds fields.

   In Water Year 2008, CWD installed a water level logger in CWD-C, the deepest monitoring well near CWD #12, a production well in the Rob Roy well field. Well CWD #12 is currently CWD's largest producer. The water level logger provides data about the aquifer response to pumping.

2. ***Continue shallow Groundwater Monitoring Program***

SqCWD continued to monitor groundwater levels in shallow wells along Soquel Creek.

3. ***Share and consolidate monitoring data among all agencies overlying the Soquel-Aptos Area Basin***

   SqCWD, CWD, Pajaro Valley Water Management Agency, the City of Santa Cruz, and Santa Cruz County continue to share data in an ad-hoc manner. A formalized data sharing program has not yet been developed.

4. ***Analyze data and assess the adequacy of the monitoring well network annually***

   Analyses of groundwater data are discussed in Section 2.

   In Water Year 2008, SqCWD began implementing recommendations in the *Evaluation of Water Quality Monitoring Network and Recommendations for Improvement* (HydroMetrics LLC, 2007) by installing new sampling equipment and identifying monitoring wells that need to be replaced.

   In 2008, bladder pumps were installed for sampling water quality at wells SC-A8B and SC-A8C; all three completions at cluster SC-A8 are now sampled using bladder pumps. Bladder pumps were also installed at wells SC-1A, SC-8A, SC-8B, SC-A2C, and SC-A4D.

   The SC-3 well cluster, well SC-8F, and well SC-9D were identified as needing replacement.

5. ***Coordinate with other groundwater resource agencies to develop uniform data collection procedures and data sharing protocols***

   Minimum standards for monitoring protocols have not yet been set for all agencies in the Soquel-Aptos Area Basin.

   SqCWD continued to support Santa Cruz County efforts to create a GIS well layer for information about municipal and private wells in Santa Cruz County.

6. ***Develop an outreach program to obtain groundwater level data from private pumpers within the Soquel-Aptos area***

   Santa Cruz County is monitoring private well groundwater levels in the Soquel-Aptos basin.

ELEMENT 2: SURFACE WATER MONITORING

1. ***Monitor stream gauges on Soquel Creek to identify and track changes in baseflow conditions***

   SqCWD continued to monitor streamflow and temperature at the Upper Soquel Creek and West Branch stream gauges. Data loggers record values every 15 minutes, and the data are downloaded and converted to daily values once a month. SqCWD continued to contribute toward the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street along with Santa Cruz County and the U.S. Geological Survey.

2. ***Monitor rainfall in the Soquel-Aptos Area Basin to establish rainfall-runoff relationship***

   SqCWD continued to collect rainfall data at the Mancarti and Kraeger/Longridge Rain Gauges within the Soquel Creek Watershed. Data loggers record values every 15 minutes, and the data are downloaded and converted to daily values once a month.

3. ***Monitor selected shallow wells adjacent to creeks to identify and quantify stream aquifer interactions. Coordinate a meeting with SqCWD and the County of Santa Cruz to discuss future analysis of the shallow well monitoring data from 2003 – 2006***

   SqCWD continued to measure shallow groundwater levels at the four monitoring sites along the eastern side of Soquel Creek: Simons, Balogh, Main Street, and Nob Hill.

   Analysis of these shallow groundwater levels was provided in the *Water Year 2007 Annual Review and Report* (HydroMetrics LLC, 2009). Santa Cruz County is on the Basin Advisory Group that reviewed the analysis.

4. ***Analyze stream gauge data, rainfall data, and shallow monitoring data annually***

   Data from the above three monitoring programs were analyzed in the *Water Year 2007 Annual Review and Report* (HydroMetrics LLC, 2009). Additional analysis is not included in this report, but it is recommended that further analysis be included in a separate report. A separate report may be necessary in the future as the surface water monitoring program is expanded to other creeks such as Aptos Creek and streamflow is monitored for changes to baseflow due to pumping from new production wells.

5. ***Support stream monitoring and management activities along Aptos Creek and Valencia Creek***
   SqCWD and CWD have not participated in any interagency meetings regarding implementation of total maximum daily load (TMDL) projects and programs in the Aptos Creek and Valencia Creek watersheds. The Aptos Creek TMDL has been adopted by the Regional Water Quality Control Board.

   As part of preparing an environmental impact report (EIR) for its Well Master Plan, SqCWD has analyzed effects of future pumping on Valencia Creek and Aptos Creek and reaffirmed its support for monitoring along the creeks, particularly Aptos Creek.

ELEMENT 3: SUBSIDENCE MONITORING

1. ***Develop and implement a GPS based subsidence monitoring program***
   SqCWD and CWD have not initiated work to develop and implement a subsidence monitoring program.

2. ***Analyze data and assess the frequency of the subsidence monitoring***
   This action item cannot be performed until a subsidence monitoring program is implemented.

3. ***Review other means of subsidence measuring and monitoring***
   SqCWD and CWD have not reviewed alternate means of measuring and monitoring subsidence.

ELEMENT 4: INTERAGENCY COORDINATION

1. ***Develop and secure a supplemental source of supply with the City of Santa Cruz***
   The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District ($SCWD^2$) desalination plant began testing in March 2008.

2. ***Continue to cooperatively manage groundwater under the provisions of the Soquel Aptos Groundwater Management Alliance (SAGMA)***
   SAGMA continues to meet semi-annually to discuss management of the groundwater basin. SAGMA makes up most of the Basin Advisory Group that reviews this annual report.

3. ***Expand the Soquel-Aptos Groundwater Management Authority to include other water resource agencies that have jurisdiction within the Soquel-Aptos area***
   The Soquel-Aptos Groundwater Management Authority has not been expanded and the area subject to the GMP remains the areas of SqCWD and CWD. However, the City of Santa Cruz has recently indicated interest in joining the GMP.

4. ***Continue to support the USGS GAMA project and work cooperatively with USGS, State, and regional agencies to improve statewide monitoring***
   The Groundwater Ambient Monitoring and Assessment Program (GAMA) last tested private and public wells in the Soquel-Aptos area in 2005 (Kulongoski and Belitz, 2007). The GAMA program intends to sample a subset of these wells every three years to establish groundwater quality trends. SqCWD and CWD will support the USGS as it conducts new sampling at wells in the Soquel-Aptos area.

5. ***Continue to support the USGS Soquel Creek Stream Gauging Station***
   SqCWD continues to contribute toward the cost to operate and maintain the Soquel Creek Stream Gauging Station at Bridge Street in Soquel.

6. ***Continue to participate and support the Northern Santa Cruz County Integrated Regional Water Management Plan (IRWMP)***
   Proposition 50 funding for projects identified in the IRWMP has been awarded. SqCWD has contracted with the State to construct monitoring wells at the Polo Grounds. SqCWD and CWD support Santa Cruz County in its use of funding for well destruction and enhancement of primary groundwater recharge areas. Funding has also been awarded for intake study costs of the regional desalination plant. The general manager of SqCWD serves on the Board of the Regional Water Management Foundation which oversees the implementation of the Santa Cruz Integrated Regional Water Management Program (IRWMP). The general manager is a member of the IRWMP steering committee.

7. ***Support implementation of Pajaro Valley Water Management Agency's (PVWMA) Basin Management Plan and PVWMA/City of Watsonville efforts to develop the Watsonville Area Water Recycling Project***
   SqCWD and CWD continue to support implementation of PVWMA's Basin Management Plan and efforts to develop the Watsonville Area Water Recycling Project.

8. ***Support PVMWA efforts to develop a numerical model of the Pajaro Valley groundwater basin***
   PVWMA efforts to develop a numerical model of the Pajaro Valley basin have been proceeding at a reduced rate. The Technical Advisory Committee for this model did not meet in 2008.

9. ***Support the Central Coast Regional Water Quality Control Board's (RWQCB) Implementation Strategy for the Aptos Watershed Sediment Total Maximum Daily Load (TMDL) Report***
   RWQCB decided in 2007 to implement management measurements for sediment impairment of the Aptos watershed through the Santa Cruz County Stormwater Management Program (Briggs, 2007). SqCWD and CWD continue to support this implementation.

ELEMENT 5: DEVELOP A SUPPLEMENTAL SOURCE OF SUPPLY

1. ***Develop and secure a supplemental water supply suitable for implementing a conjunctive use program***
   The pilot plant for the Santa Cruz Water Department/Soquel Creek Water District (SCWD^2) desalination plant began testing in March, 2008. A tentative priority schedule for water produced at the plant will provide at least 1,148 acre-feet per year to SqCWD for implementing a conjunctive use program.

2. ***Explore and pursue funding opportunities for supplemental supply projects***
   SqCWD and CWD supported the IRWMP that was awarded Proposition 50 funding for intake study costs related to the desalination plant. SqCWD also received grant funding to study the feasibility and cost-effectiveness of constructing satellite reclamation plants to provide recycled water.

ELEMENT 6: PROTECT EXISTING RECHARGE ZONES

1. ***Support existing Santa Cruz County efforts to update Groundwater Recharge Maps that identify primary groundwater recharge zones***
   SqCWD and CWD continue to support Santa Cruz County efforts to update these maps. The County has updated primary groundwater recharge maps using electronic GIS data on soils and geology. The County is now considering mapping secondary recharge areas, and is updating primary recharge maps as information becomes available on a site specific basis.

2. ***Support PVWMA's efforts to optimize recharge recovery, and develop an ASR (Aquifer Storage and Retrieval) Project in the Aromas Red Sands***
   SqCWD and CWD support PVWMA's implementation of its Harkins Slough Aquifer Storage and Recovery (ASR) Project. This ASR project involves seasonal percolation of diverted Harkins Slough water into the Harkins Slough recharge basin for storage until the irrigation season, when it is extracted and delivered to the Coastal Distribution System (CDS) for distribution. The construction of the Harkins Slough diversion structure and recharge basin was completed in Fall 2001. The project has operated every year since 2002. Between 2002 and 2008, nearly 4,500 acre feet of water have been diverted from Harkins Slough and pumped to the percolation pond. Recovery wells have extracted approximately 1,000 acre feet of diverted water distribution in the CDS. The remaining water that is not recovered recharges the Alluvial and Aromas Red Sands aquifers.

3. ***Support future efforts to characterize recharge areas within the Soquel-Aptos area***
   The data from the GAMA project (Kulongoski and Belitz, 2007) are expected to include chemical analyses that will help characterize recharge areas. A full review of these data to perform this characterization has not taken place.

4. ***Coordinate and expand efforts between groundwater management agencies and the County of Santa Cruz to establish regulations for land use within Primary Recharge Areas***
   The County has formed a technical advisory committee to develop grant funded recharge demonstration projects and participate in the update of recharge and stormwater policies to protect and restore recharge.

ELEMENT 7: ENHANCE GROUNDWATER RECHARGE

1. ***Enhance groundwater recharge with stormwater runoff***
   SqCWD and CWD continue to support Santa Cruz County efforts to identify projects to enhance groundwater recharge. The County has formed a technical advisory committee to develop grant funded recharge demonstration projects. The Resource Conservation District of Santa Cruz County is also implementing a separate grant funded project to promote recharge through home drainage improvements, including outreach and

technical assistance. In 2008, SqCWD budgeted $50,000 to supplement Proposition 50 funding awarded to the County for recharge projects.

CWD supported Aptos High School with its recharge pond project.

2. ***Develop and implement standards that require discretionary projects in primary recharge zones to maintain or increase a site's pre-development absorption of runoff***
   SqCWD and CWD continue to support County efforts to develop a program that will include standards regulating impervious surfaces and provide measures to increase groundwater recharge.

3. ***Support County of Santa Cruz efforts to prioritize potential sites for drainage facilities, and implement construction***
   SqCWD and CWD continue to support County efforts to identify drainage facilities with potential for groundwater recharge. SqCWD has budgeted funds to supplement Proposition 50 funds awarded to the County for implementation of these projects.

4. ***Participate in public outreach and awareness for groundwater recharge***
   SqCWD and CWD have yet to develop educational programs to inform the public of techniques for increasing groundwater recharge.

5. ***Investigate the water storage potential of the Aromas Red Sands***
   SqCWD and CWD continue to explore potential projects for enhanced recharge in the Pleasant Valley/Freedom Blvd. area.

ELEMENT 8: MANAGE PUMPING

1. ***Locate, design, and install additional and replacement production wells to improve pumping distribution, disperse the basin's overall drawdown and improve operational flexibility***
   SqCWD drafted its analysis of the effects of pumping new wells identified in its Well Master Plan, as well as the effects of redistributing pumping over the expanded well network. The EIR for the Well Master Plan is scheduled to be completed this year. Installation of the first of the new production wells is scheduled for 2010.

2. ***Continue to encourage private well users located within critical groundwater areas of the Soquel-Aptos basin to discontinue pumping and connect to the local municipal water supply systems***
   SqCWD continued to use its Private Well Incentive Policy to encourage private well users located in critical groundwater areas to properly abandon their wells and connect to the District's distribution system.

3. ***Cooperatively work with City of Santa Cruz to develop a coordinated pumping plan for the City's Live Oak wells and SqCWD's Purisima wells***
   SqCWD and the City of Santa Cruz exchanged proposals for a Cooperative Groundwater Management Agreement in water year 2008. The two agencies continue to discuss creating an agreement for cooperative management of this area of the basin.

4. ***Analyze groundwater level/quality data and groundwater pumping data at least annually, and recommend changes to the groundwater pumping distribution as necessary***
   This analysis is completed in Section 2. HydroMetrics LLC has made informal recommendations to SqCWD for changes to groundwater pumping distribution, but significant changes to the pumping distribution cannot be made until the Well Master Plan is implemented.

ELEMENT 9: IDENTIFY AND MANAGE CUMULATIVE IMPACTS

1. ***Encourage sustainable pumping from non-agency groundwater users***
   SqCWD is considering expanding its water demand offset program to reduce pumping from non-agency groundwater users in the Basin, including private pumpers and small water systems.

2. ***Identify and manage well interference and manage groundwater storage for beneficial uses and drought reserve***
   Groundwater levels in production wells are monitored to assess whether cones of depression from other wells have caused lowered groundwater levels that result in an appreciable diminution in the quantity or quality of water pumped by that well. Based on monitoring data, well interference between the three agencies that operate municipal production wells in the Soquel-Aptos Area Basin has not been identified as an issue at this time. Well interference has been identified as an issue within the SqCWD system. Well performance has been affected at the Estates and T. Hopkins wells due to their cumulative drawdown.

3. ***Install new wells in locations that reduce cumulative impacts***

   Cumulative effects of pumping the new wells in the Well Master Plan have been analyzed. Based on planned redistribution of pumping, the net cumulative effects of the Well Master Plan should be beneficial.

   Two of the new wells in the Well Master Plan, the Austrian Way and Granite Way wells, are intended to alleviate the identified cumulative impacts that affect the performance of the Estates and T. Hopkins wells.

4. ***Continue to improve and quantify projected future demands from all groundwater users***

   Projections of future demands have not been updated since SqCWD's *Integrated Resources Plan* (ESA, 2006) as of Water Year 2008. These projections will be revised in Water Year 2009.

ELEMENT 10: WATER CONSERVATION

1. ***Continue and update the existing water conservation programs for SqCWD.***
   SqCWD continued its existing water conservation programs. It is considering expanding its water demand offset program to reduce water usage by non-District customers.

2. ***Continue and update the existing water conservation programs for CWD.***
   CWD continued its existing water conservation programs and began development of a drought tolerant demonstration garden.

3. ***Annually report estimated savings from the ongoing water conservation program.***
   Water production by SqCWD in water year 2008 was the fourth straight year when production was approximately 600 acre-feet less than the previous ten-year period (1995-2004). Much of this continuing reduction is attributed to SqCWD's on-going conservation programs.

ELEMENT 11: SUPPORT THE DEVELOPMENT AND UPDATE OF POLICIES AND ORDINANCES FOR WELL CONSTRUCTION, ABANDONMENT, AND DESTRUCTION

1. ***Support existing well construction and well destruction standards, including the recent revisions to the County of Santa Cruz Well Ordinance***
   SqCWD and CWD worked closely with Santa Cruz County to implement revisions to the water well ordinance that went into effect March 23, 2009. SqCWD will follow the revised ordinance when replacing monitoring wells SC-3, SC-8F, and SC-9A, abandoning SC-5D and constructing the new monitoring well cluster at Polo Grounds.

2. ***Support County of Santa Cruz's well destruction program***

   SqCWD and CWD supported Santa Cruz County's well destruction program. With the support of the agencies through the IRWMP, the County was awarded Proposition 50 water bond funding for the program.

SqCWD has identified wells at the County's Polo Grounds park for abandonment. Monitoring well SC-5D has also been identified as needing proper destruction.

3. *Continue to implement SqCWD well destruction policy*
   SqCWD continues to require property owners to properly destroy abandoned private wells before connecting to the SqCWD system.

4. ***Request Santa Cruz County Environmental Health Services to establish a voluntary monitoring program of private wells, particularly in inland areas of the Soquel-Aptos groundwater management area***
   The County has implemented this voluntary monitoring program of groundwater levels.

ELEMENT 12: WELLHEAD PROTECTION MEASURES

1. ***Periodically update and review the SqCWD and CWD Drinking Water Source Assessment and Protection (DWSAP) analysis and submittals.***
   SqCWD has not updated DWSAP analysis and submittals since the GMP has been enacted. CWD has been working to update its inventory of potentially contaminating activities and update DWSAP reports for its six wells. CWD's updated DWSAP should be completed in 2009.

2. ***Continue to assist with and endorse Santa Cruz County's expanded wellhead protection programs.***
   SqCWD and CWD continue to support Santa Cruz County's programs.

3. ***Support groundwater remediation activities.***
   SqCWD and CWD continue to support the State and Santa Cruz County's programs such as regulation of the cleanup and monitoring of sites with known or potential contamination by the Central Coast Regional Water Quality Control Board (RWQCB) and Santa Cruz County Department of Environmental Health, submittal of the MTBE Report to Public Water System Operators (RWQCB), and use of the State's Underground Storage Tank Cleanup Fund.

ELEMENT 13: PUBLIC EDUCATION

1. ***Maintain SqCWD's Public Information Program***

SqCWD continued to conduct its public information program.

2. ***Maintain SqCWD School Education Program***
   SqCWD continued to conduct its school education program.

3. ***Maintain CWD Public Education Programs***
   CWD continued to conduct its public education programs and began development of a drought tolerant demonstration garden..

4. ***Support and participate in regional programs***
   SqCWD continued to support and participate in regional programs.

ELEMENT 14: IMPROVE GROUNDWATER BASIN MANAGEMENT TOOLS

1. ***Continue to improve and quantify sustainable yield estimates***
   Sustainable yield estimates are currently being re-evaluated based on modeled offshore flows required to achieve water levels protective against seawater intrusion (HydroMetrics LLC, 2009b).

2. ***Establish water levels that protect the groundwater basin against seawater intrusion***
   SqCWD has established protective water levels at its coastal monitoring wells as documented in *Groundwater Levels to Protect against Seawater Intrusion and Store Freshwater Offshore* (HydroMetrics LLC, 2009b).

3. ***Assist state, federal, or local wildlife and fisheries agencies as they develop water flow or water quality requirements for riparian and aquatic organisms***
   SqCWD continued its ongoing funding and review of stream habitat and juvenile salmonid (steelhead and coho salmon) monitoring in the Soquel and Aptos Creek watersheds as part of the Santa Cruz County Stream Habitat and Juvenile Salmonid Sampling Program.

4. ***Maintain and enhance data collection and management.***
   Data collection has been enhanced by installing new sampling equipment in several of SqCWD's wells. There are also plans to install water level sensors in production wells to facilitate real-time management of pumping.

   SqCWD and CWD continue to update the agencies' databases and Geographical Information Systems.

5. ***Ensure data sharing among regional water agencies***
   A formal process for data sharing among regional water agencies has not been developed.

6. ***Explore methods to collect data from non-agency groundwater users***
   Mechanisms to collect pumping data from non-agency users have not been developed. The County has implemented a voluntary monitoring program of groundwater levels at private wells.

7. ***Prepare a subregional groundwater model for CWD's Rob Roy Well Field***
   A subregional model for the Aromas area was prepared for CWD as a tool to delineate well capture zones in the updated DWSAP reports.

8. ***Provide data and technical assistance to Pajaro Valley Water Management Agency (PVWMA) Groundwater Basin Model***
   Development of the Pajaro Valley model has been proceeding at a reduced rate. The Technical Advisory Committee for this model did not meet in water year 2008.

9. ***Explore opportunities to expand existing groundwater models to cover the Soquel-Aptos area***
   Opportunities to convert the existing IGSM model to a tool that will be useful for groundwater management have not been developed.

10. ***Explore methods to measure and locate the seawater/freshwater interface***
    Methods to locate the seawater/freshwater interface have not been explored. SqCWD is developing an analysis of the rate and depth of seawater intrusion in the Aromas area.

3.3 BASIN MANAGEMENT ACTION PRIORITIES

The top priorities for projects and programs to achieve BMOs are listed as follows.

1. Regional Desalination Plant (Element 5, BMO 1-2). Many BMOs rely on successfully securing a supplemental supply and achieving BMO 1-2. The regional desalination plant is currently the most likely supplemental supply option.

2. Well Master Plan (Element 8). SqCWD should complete the Well Master Plan EIR so that additional wells can be installed to better effectively manage pumping in the basin.

3. Replace identified monitoring wells (Element 1). To obtain useful groundwater data from these parts of the monitoring network, SqCWD should replace the monitoring well cluster SC-3, and monitoring wells SC-8F and SC-9A.

4. Manage well operation based on pumping water levels (Element 8). SqCWD should test water level dependence of specific capacity at the Estates well and install water level sensors in production wells to better manage pumping based on current water levels.

5. Install monitoring wells at Polo Grounds (Element 1). To expand the groundwater monitoring network near a future location of municipal production and Valencia Creek, SqCWD should install these monitoring wells when the state funding for the installation becomes available.

6. Continue to upgrade groundwater monitoring equipment (Element 1). SqCWD should continue to follow recommendations in *Evaluation of Water Quality Monitoring Network and Recommendations for Improvement* for replacing groundwater sampling equipment to improve sampling efficiencies. Upgrades may also include installing additional water level sensors in monitoring wells for extended periods of time to monitor continuous water levels for comparison with pumping operation.

7. Support County efforts for recharge enhancement (Element 7). SqCWD should use its budgeted funds to help advance County projects for recharge enhancement.

8. Expand water demand offset program (Element 10). SqCWD should develop guidelines for expanding funding of conservation efforts to non-District users of groundwater through developer funded programs.

9. Investigate alternative supplemental supplies, such as satellite reclamation plants (Element 5). SqCWD should continue to proceed with alternatives to desalination as a supplemental supply. One option is for SqCWD to pursue funding for construction of satellite reclamation plants to provide recycled water.

10. Survey elevations of monitoring wells that have not been surveyed (Element 1). Accurate water level elevations depend on accurate survey information for well reference points. The SC-11, SC-A6, and SC-A7 monitoring wells do not have reference point elevations. The SC-11 wells at Porter Gulch are the highest priority for surveying because there is no nearby production well with survey information. SqCWD should survey these wells, probably when wells are replaced or monitoring wells are installed at Polo Grounds.

Section 4
CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

Precipitation for Water Year 2008 was more than for Water Year 2007, but still less than average annual amounts. This lower than normal rainfall for the second consecutive year translates to less groundwater recharge in the basin. Although year to year changes in recharge are unlikely to significantly impact groundwater levels, a long term decline in precipitation and recharge will result in lower groundwater levels..

SqCWD groundwater pumping decreased slightly during Water Year 2008, remaining below historical averages. Total groundwater pumping by SqCWD was approximately 1,560 million gallons, or 4,795 acre-feet. This is below SqCWD's target limiting groundwater production to not more than 4,800 acre-feet per year.

Total SqCWD pumping from the Purisima area during Water Year 2008 was 958 million gallons, or 2,941 acre-feet. This is slightly below SqCWD's target value of 3,000 acre-feet. Pumping shifts in the Purisima included decreases in pumping at the Main Street and Aptos Creek wells accompanied by increases in pumping at the Tannery well.

Total SqCWD groundwater pumping from the Aromas area increased by 21 acre-feet from Water Year 2007. SqCWD pumped 604 million gallons, or 1,854 acre-feet from the Aromas area during Water Year 2008. Aromas area pumping remains above SqCWD's target value of 1,800 acre-feet per year. Significant pumping shifts in the Aromas area included decreases in pumping from the San Andreas, Bonita, and Altivo wells. These reductions were accompanied by an increase in pumping from the Aptos Jr. High well which came online in March 2007 after being idle since 1986. The Sells well also had a significant increase in Water Year 2008 pumping which was approximately six times greater than pumping in Water Year 2007.

CWD pumping decreased slightly in Water Year 2008. CWD pumped 583 acre-feet during Water Year 2008, approximately 12 acre-feet less than the amount pumped in Water Year 2007. Almost all of CWD's water is pumped from the Aromas Red Sands.

4.1.1 GROUNDWATER LEVELS

Important groundwater level trends observed during Water Year 2008 include the following:

- Groundwater levels at monitoring well SC-1A were maintained above sea level during Water Year 2008. This is an area where the Purisima Formation is believed to be particularly vulnerable to seawater intrusion.

Average groundwater levels in all coastal monitoring wells completed in the Purisima A-unit were slightly lower in Water Year 2008 than Water Year 2007. However, the recent groundwater level trend in these wells has been stable or slightly increasing since Water Year 2004.

- Groundwater levels in the inland monitoring well SC-10AA continued on a downward trend to a new historically low level.

- Groundwater levels in the City of Santa Cruz's Thurber Lane Deep monitoring well continued to decline.

- Groundwater levels in the City of Santa Cruz's Thurber Lane Shallow monitoring well continue to remain stable and remain at an elevation of approximately 104 feet above mean sea level.

- Purisima BC-unit groundwater levels in the coastal monitoring wells SC-8 and SC-9 increased slightly from the historically low levels observed at the end of Water Year 2007. Overall however, the BC-unit wells have decreasing groundwater level trends that are well below sea level.

- Inland, groundwater levels in the Purisima BC-unit remain below sea level, and have continued to decline despite increasing from the historically low levels observed in Water Year 2007.

- Groundwater levels in the Aromas area remained relatively constant throughout Water Year 2008.

- Coastal groundwater levels throughout the basin remained below levels estimated to be protective against seawater intrusion.

4.1.2 GROUNDWATER QUALITY

Important groundwater quality trends include the following:

- Seawater intrusion has not been detected near monitoring well SC-1A, an area considered at risk for seawater intrusion.

- The Purisima Formation in the western portion of the SqCWD service area including monitoring wells SC-1, SC-3 and the Main Street well, has historically shown a very slowly increasing chloride and TDS trend. Chloride concentrations range from 20 – 48 mg/L, which is well below the drinking water maximum contaminant limit (MCL) of 250 mg/L.

- The Purisima Formation in the central portion of the SqCWD service area including the Tannery well and SC-5 monitoring wells, has historically shown slightly increasing chloride and TDS concentrations at the coast but stable inland concentrations. Chloride concentrations range from 60-70 mg/L, which is well below the MCL of 250 mg/L.

- The Purisima Formation in the eastern portion of the SqCWD service area, from the Estates well to the SC-8 monitoring well cluster, has historically shown slowly increasing chloride and TDS trends at the coast but more stable inland concentrations. Chloride concentrations range from 13-51 mg/L, which is well below the MCL of 250 mg/L.

- The sole area of high chlorides in the Purisima Formation that might be indicative of seawater intrusion is seen in the shallowest monitoring well near the mouth of Aptos Creek (well SC-8F).

- Chloride spikes in the SC-8 monitoring wells in 1992, and 1998 to 2002, are probably due to laboratory error. Chloride concentrations of approximately 3,000 mg/L over the past two years have been consistent, however because of sanding in the well, these results cannot be considered completely reliable.

- Seawater intrusion continues to move inland in the Aromas area at well cluster SC-A2 in the Rio Del Mar area, and at well cluster SC-A3 in the La Selva Beach area.

- Production wells in the Aromas areas have historically shown slightly increasing trends in chloride and TDS concentrations but their chloride concentrations are less than 40 mg/L, which is well below the MCL of 250 mg/L.

4.1.3 GROUNDWATER MANAGEMENT

Groundwater pumping remained relatively low for the fourth year in a row. For the first time SqCWD's pumping was just below its current pumping goal. Reduced total pumping and shifting of pumping during the last four water years has led to improved groundwater level conditions in the Purisima A-unit coastal monitoring wells where levels remained stable or show a trend of increasing groundwater levels.

Groundwater levels in the Purisima BC-unit measured in the SC-8 and SC-9 coastal monitoring well clusters have continued to decline further below sea level. This decline is likely due to increases in SqCWD pumping in the BC-unit in Service Area II.

It is unclear whether the sustainable yield pumping goal set by SqCWD is adequate to completely prevent seawater intrusion. Successful groundwater management involves both pumping rates and pumping locations. As SqCWD implements the Well Master Plan, pumping locations will change, improving groundwater management. Only after pumping within the target goal for a number of years, moving pumping to new locations, and evaluating the impacts of pumping by other users, can the adequacy of SqCWD's target pumping goals be assessed.

4.2 RECOMMENDATIONS

1. Further reduce pumping in the Purisima BC-unit.

2. Reassess the adequacy of SqCWD's target pumping goals.

3. Secure a supplemental supply that will help relieve stresses on the basin.

4. Implement the Well Master Plan to redistribute pumping in the basin.

5. Continue to investigate additional water supplies, such as:
   a. Recharge,
   b. Reclaimed water, and

6. Install transducers in productions wells and manage well operation based on pumping groundwater levels measured by the transducers.

7. Continue to upgrade monitoring well network:
   a. Replace wells SC-3, SC-8F, SC-9A,
   b. Install Polo Grounds monitoring wells, and
   c. Upgrade sampling equipment.

8. Survey elevations of monitoring wells that have not been surveyed.

9. Evaluate declining water levels in the Purisima Tu and AA units.

10. Check on all historical results from Soils Laboratory and update database.

A further suggestion is to reconsider the usefulness of the one, five and ten year difference contour maps. The difference contour maps are highly influenced by the operational factors prior to the groundwater levels being recorded and are not completely representative of what is occurring overall in the aquifer. This can be seen in Figure 9, where an increase in groundwater levels is shown at the Tannery well when in fact the well pumped more during Water Year 2008 than in Water Year 2007, and should have shown a decline.

Furthermore, groundwater level readings may also be affected by whether nearby wells were pumping at the time measurements were taken. For example, a monitoring well located adjacent to a pumping well which is pumping at the time the water level is measured will result in a much lower pumping level being recorded than if the pumping well is not pumping at the time of measurement. The approach of producing groundwater level change maps, particularly over the short-term, may therefore not be representative of overall trends taking place in the aquifers. To understand what the trends are, we recommend evaluating individual hydrographs.

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Section 5
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